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An electric carriage for use on common roads has been built by G. K. Cummings, of Chicago, and a company is to be formed for its manufacture. The vehicle is a four-wheeled two-seater, and has made 10 to 12 miles per hour over level city roads, consuming 1¼ to 2 E. HP. The rear axle is driven from the motor (a 2-HP. series wound machine) by a sprocket chain. The current is furnished by 200 storage battery cells placed under the carriage seats.

The heaviest mogul locomotive in the world is one recently built by the Baldwin Locomotive Works for the Delaware, Susquehanna & Schuylkill Ry., weighing 76 tons, while the heaviest engine of this type previously built is said to have weighed 61 tons. The engine has a straight boiler, a firebox for lump anthracite fuel, extension smokebox with short pipe smokestack, and the two-bar or alligator form of guidebars. It has a Leach air-sanding device (Eng. News, Feb. 13, 1892) and an air bell-ringer. The tender has plate frames and is carried on six wheels, an arrangement already tried by the Pennsylvania on an express compound engine (Eng. News, March 29, 1894). The dimensions of the mogul engine are as follows:

Driving wheels, diam.	5 ft. 2 ins.
Truck wheels, "	2 " 11½ "
Tender wheels, "	3 " 6 "
Journals, driving axles	9 × 12 ins.
" truck axles	6 × 12 "
" tender axles	6½ × 10 "
Wheelbase, driving	14 ft. 0 ins.
" total engine	22 " 5 "
" engine and tender	50 " 0 "
Weight in working order	151,000 lbs.
Cylinders	22 × 26 ins.
Valve gear	Stephenson link
Slide valves	Richardson balanced
Boiler, diameter	6 ft. 0 ins.
" plates	5/8-in.
Boiler pressure	160 lbs.
Firebox, size inside	11 ft. 0 7-16 in. × 3 ft. 5⅞ ins.
" side and back plates	5-16-in.
" crown sheet	3/8-in.
" tube sheet	½-in.
" staybolts, diameter	7/8-in.
" water space; sides and back, 3 ins.; front 4 ins.	
Tubes, number 270; thickness	iron, No. 13 B. W. G.
" diameter, 2¼ ins.; length	12 ft. 0 ins.
Brake fittings	Westinghouse-American

The legality of a $6,000,000 bond issue by the city of Philadelphia, to defray one-half the expense of abolishing Philadelphia & Reading grade-crossings, has been decided affirmatively by the Supreme Court of Pennsylvania. The decision involved the broader question as to whether certificates of city debt purchased and held by the Sinking Fund Commission and now amounting to $23,000,000, constitute a part of the city's debt, the total of which, by the state constitution, must not exceed 7% of the assessed valuation of the city. The court decided that since these certificates had been bought with the city's money its obligation to raise money to redeem them had ceased and that they should no longer be considered in this connection as a part of the city debt. This decision gives the city power to issue some $17,000,000 of improvement bonds, in addition to those for subway purposes.

An appropriation of $150,000 for a Morison-Jewel mechanical filtration plant for the water-works of Providence, R. I., has been voted by both branches of the city government. Sulphate of alumina will be used in connection with the filters.

The New York and New Jersey bridge bill was passed by the Senate on June 5. The question of permitting a pier in the river is to be decided by a board of engineers, subject to the approval of the Secretary of War. The center of the bridge is to be 150 ft. above high water at spring tides. The bridge must be completed within ten years.

The Nicaragua Canal & Construction Co.'s property and assets have been sold to John R. Bartlett for $297,625. The report of the receiver, Mr. T. B. Atkins, showed that the property disposed of consisted of 148,711½ shares of the capital stock of the Maritime Canal Co. of Nicaragua, a contract between that company and the Nicaragua Canal & Construction Co., and obligation of the Maritime Canal Co., dated Jan. 3, 1890, to deliver to the Nicaragua Canal Co., dated Jan. 3, of its first mortagage bonds and 2,578½ shares of the treasury stock of the company.

The railway accidents of the last few weeks have been comparatively few and unimportant, but during the past week there have been three more than usually serious accidents. The worst of these was caused by a misplaced switch at Marshfield, Wis., on the Wisconsin Central Ry., on May 30. The train was derailed by the engine wheels striking the tongue rail of the split switch, and the cars were telescoped and upset. The wreck caught fire from the car stoves and was destroyed, some of the bodies also being burned. There were six persons killed and about ten injured, some very seriously. The switch is said to have been tampered with.—The derailment of the rear car of an excursion train near Albany, Ga., on the Georgia Central Ry., May 30, resulted in injuries to about 50 passengers, three of whom will probably die. The car jumped the track and rolled down a 20-ft. bank.—The third accident was a rear collision at Sharon Heights, Mass., on the Providence Division of the Old Colony R. R., May 30. A southbound local freight was switching, and the rear cars were switched onto the northbound track, where they were run into by a northbound strawberry train. Three persons were killed and two injured. It is stated that the flagman of the local train did not go back far enough.

A crossing collision occurred at Perth Amboy, N. J., June 4, at the crossing of the Lehigh Valley and New York & Long Branch railways. The crossing is protected by signals, and a passenger train on the latter road was given the right of way. A train of empty cars, approaching on the Lehigh Valley tracks, did not stop and struck the passenger train between the mail car and baggage car, throwing both the cars over and derailing the Pullman car next to the baggage car. Nobody was seriously injured.

A small bridge on the Northern Pacific Ry., near Topponick, Wash., was undermined by the floods and gave way under a freight train May 27.

Four gates of the Welland Canal lock at Port Dalhousie, Ont., were carried away by the steamer "City of Windsor" on May 30, owing to the ship's headway breaking the mooring lines.

The Laconia Car Works, Laconia, N. H., were destroyed by fire on June 3, causing a loss of $100,000. The works are to be rebuilt at once.

Heavy storms and floods in various sections of the country have caused considerable damage to railway and other property, and to the crops. Washington and British Columbia have suffered severely. At Pueblo, Colo., the Arkansas and Fountain rivers burst the levees, flooding the lower part of the town, in some places as deep as the second stories of the houses, and several lives were lost. The water-works pumping station and electric light station were flooded, and the fires put out.

The engine power of the triple-screw cruiser "Columbia," as developed on her recent trial trip, was as follows, according to the report of the Naval Board. With six boilers and three screws in use, steam pressure 105 lbs., revolutions 92, the power developed was 6,879 HP. at a speed of 16.41 knots. At 10.06 knots, with one screw, 128 lbs. of steam and 73.7 revolutions, the engines showed 1,751 HP. At 18.4 knots, three screws, all boilers, 133 lbs. of steam and 106 revolutions, the power was 9,757 HP.

A storage battery omnibus with seats for 26 passengers is being tried in London. There are two batteries of accumulators, weighing 17 lbs. each.

The improvement of the St. Johns River, in Florida, is now completed, giving 18 ft. of water at low tide from Jacksonville to the sea, and 20 ft. at high tide. The work has cost $300,000, and consisted of dredging and jetty work, the former being done by the San Francisco Dredging Co., and the latter by R. G. Ross.

A test of quick firing guns was made June 1 at the proving grounds at Sandy Hook. The pieces were the Driggs-Schroeder, the Sponsel, the Maxim-Nordenfeldt, the Hotchkiss and the Skoda. The only American gun was the Driggs-Schroeder. They are all six-pounders, with the exception of the Skoda, which is a three-pounder. The trial showed that the Driggs-Schroeder gun was easier to handle than any of the others, and had the advantage of rapidity of fire, discharging 34 shots in one minute and 83 in three minutes.

A rain-making expedition is reported as having been sent out in Nebraska by the Chicago, Rock Island & Pacific Ry., and is said to have met with success. In one case, however, a hailstorm followed the experiments, damaging crops and windows, for which the owners propose to sue the railway. The method is kept secret, but seems to be the preparation of a gas which rises to the upper strata of air and produces conditions favorable to a rainfall.

The latest invention in destructive war material is an electric mitrailleuse firing a torrent of bullets charged with a poisonous or suffocating gas. This interesting implement for making war merely wholesale slaughter (and therefore tending to prevent war, perhaps) is the invention of M. Turpin, the French inventor of melenite, the now well known explosive. No details are given, but the French war department rebuffed the inventor, and he made arrangements to sell the patents to the German war department, but reconsidered the idea from patriotic motives, so it is said.

Two fast Atlantic trips from Southampton to New York were made last week. The "Normannia," of the Hamburg-American Line, made a run of 3,103 miles in 6 d. 12 h. 41 min., while the "Paris," of the American Line, made a record of 6 d. 9 h. 37 min. for a run of 3,052 miles.

The powerful electric searchlight used on the top of the Manufactures Building at the World's Columbian Exposition last year, has been erected on a tower at the proving grounds at Sandy Hook, 200 ft. above sea level. Ships can be detected at a distance of several miles.

Electrical subways are to be built in St. Louis and in Kansas City. In the former city it is proposed to have the subway built, owned and managed by the city; but a franchise was granted some time ago to a private company which proposes to go ahead and parallel the city's conduits, the very thing which municipal ownership is designed to avoid. In Kansas City the subways are to be built by a private company, to which the city will grant an exclusive franchise, and the city will subscribe for a certain amount of stock at the outset and reserve the right to purchase additional amounts from time to time.

New water-works for Sagua La Grande, Cuba, are now nearly ready to be put in use, making the third city on the island with a complete system of works. The other two cities having works are Habana and Matanzas, while Cardenas and Cienfuegos each have a partial system with urgent need of a largely increased supply and distribution. The supply for Sagua La Grande will be from springs in the Rio Beanco Valley, 88 ft. above street grade. The supply pipe is 30,000 ft. in length, laid practically in a straight line and to grade with only one special, and that a 1-16 bend. Plans for the works were made by Mr. Cardena Cienfuegos, and Mr. J. Warren Lamb, of Cooperstown, N. Y., to whom we are indebted for this information, was constructing engineer. The pipe, valves and hydrants were from R. D. Wood & Co., Philadelphia. The cost of the works, including 40,000 ft. of 10 to 3-in. pipe and 40 hydrants, will be about $75,000.

A naval coaling station and harbor of refuge on the coast of Southern Florida is proposed at Santa Lucia Inlet, a point about 400 miles south of Jacksonville.

STAND-PIPE ACCIDENTS AND FAILURES.*

By Prof. Wm. D. Pence.

(Concluded from p. 423.)

Perhaps the most striking and important fact developed by this classification is the relatively large number of failures in which the plates were of steel. In order to present this comparison in the most forcible manner, the accidents have been classed in Table IV. with reference to the kind of material in which the initial weakness developed; for in this inquiry it is, for instance, manifestly of little importance what kind of plate metal was used in the construction of the tank itself in the case of a stand-pipe whose failure was due to a defective foundation. Upon this basis, Table IV. shows that of the fifteen cases probably due in a direct manner to the failure of plate metal, twelve were of steel and three of wrought iron, nine of the former and two of the latter being total failures, and each of them occurred under water or ice strains, as shown by Table III. The contrast in the record of the two metals is rendered perhaps even more striking by the excellent behaviour of the wrought iron plate under severe conditions in the case of the Stevens' Point accident, and also by the fact that during the construction of at least two of the steel stand-pipes (Sandusky and Cincinnati), numerous structural tests of the plate-metal were made and strict inspection of the work was enforced. In the same connection it is not improper to mention the defective design in the case of the Cleveland accident, and also to note that the failure of the wrought iron stand-pipe at Jersey City, in 1869, seems to have been partly due to damage sustained in erecting it by a method now obsolete. On the other hand, attention should be given to the fact that at least two of the failures of steel stand-pipes (Defiance and Asheville) due, in part at least, to defects in plates, were in every sense preventable on account of the distinct previous knowledge of the flaws.

The marked recent tendency toward the use of steel in stand-pipe construction seems, at first thought, in direct opposition to the above contrast in the past record of the two metals, which unmistakably favors wrought iron; but in addition to the facts presented in the foregoing record of accidents and failures, a just and complete comparison involves the consideration both of the respective stages of development in the processes of manufacture of the two metals, and also of the relative extent of their adaptation to this class of construction, at any given period. Upon this basis the excellent record of wrought iron above referred to seems mainly due to the fact that the process of making it had been brought to a high degree of perfection prior to its use for stand-pipe construction, while in the case of steel the grades ordinarily available during the earlier period of its use for this purpose lacked uniformity, and were often very deficient in the qualities essential to such construction. However, the rapid development in the art of steel-making, stimulated as it has been by the increased knowledge growing from the extensive use of the metal in all classes of structural work,

TABLE IV.—Classification of Stand-Pipe Accidents and Failures with Reference to Kind of Material which Failed First.

Accidents and failures which occurred under pressure of water or combined ice and water strains.

Plate metal, steel.—Sandusky (P.), Sandusky (P.), Cincinnati (T.), Gravesend (T.), Seneca Falls (T.), Temple (T.), Defiance (D.), Defiance (T.), Asheville (T.), Maryville (T), East Providence (T), Peoria (T); Total, 12.

Plate metal, wrought iron.—Cleveland (T.), Jersey City (T.), Stevens Point (D.); total, 3.

Hoops, wrought iron.—Newport (T.), Nappanee (T.), Wheatland (T.); total, 3.

Inside ladder, wrought iron.—Greencastle (D.).

Collapsed at top or overturned by pressure of wind (see Table V.).

Steel, Caldwell (P.), Asheville (D.), Plattsmouth (D.), East Providence (D.); total, 4.

Wrought iron.—Victoria (P.), Kankakee (T.); total, 2.

Failure of Masonry.

Brick tower.—Franklin (T.), Thomasville (P.); total, 2.

Concrete foundation.—Lexington (T.).

T. denotes total failure; P., partial, and D., slight damage.

has led to the present comparatively high degree of perfection in the processes by which uniform grades of steel having specified physical properties may be produced, and at a cost not only much less than formerly, but also low enough to successfully compete with wrought iron. Much light might be thrown upon this comparison of the two metals by a complete and reliable record showing the dates of construction and the kind of metal used in each stand-pipe in the United States, but no such record complete enough to warrant definite conclusions has yet been compiled. A partial list of this kind, prepared and published in 1888 (see Manual of American Water-works, 1888), is classified in Table X.

The data presented in this table are, however, of too meager a character to warrant anything beyond mere inference, since the compiler of the partial list from which it was prepared states that it "includes barely half the stand-pipes in the United States" (in 1888). The difficulties surrounding the collection of complete and entirely credible data of this class are very great; thus, for instance, of the 168 stand-pipes included in Table X. the date of construction is uncertain in 63 cases (38%), and the kind of plate metal used is lacking in 45 cases (27%). Cutting out the uncertain figures, there remain 20 steel, 78 wrought iron and one combination stand-pipe, from which it may perhaps be inferred that in 1888 the number of steel stand-pipes in the United States was about one-fourth of the number built of wrought iron, which, if true, makes the superior record of the latter metal even more striking. It appears from Table X. that steel was first extensively applied to the construction of stand-pipes about 1886, for of the 20 steel stand-pipes whose dates are given, 14, or more than two-thirds, were built in 1886, 1887 and part of 1888, while in the same period the decrease in the number of wrought iron stand-pipes built is very distinctly shown, being 18 in 1885, 17 in 1886, 7 in 1887 and but one in the part of 1888 included in the table. Allowing for a reasonable discrepancy in the above

TABLE X.—Classification of a Partial List of Existing Stand-Pipes in the United States in the Year 1888, with Reference to Date of Construction and Kind of Metal.

Year.	Steel.	Wrought iron.	Steel & w. i.	Uncertain.	Total.
1854	..	1	..	..	1
1860	..	1	..	..	1
1861	..	..	..	1	1
1868	..	1	..	..	1
1872	..	1	..	..	1
1874	..	1	..	..	1
1876	1	..	..	..	1
1877	..	2	..	..	2
1878	..	..	..	1	1
1880	..	3	..	..	3
1881	..	2	..	..	2
1882	2	5	..	1	8
1883	1	6	..	1	8
1884	1	12	..	..	13
1885	1	18	..	..	19
1886	6	17	1	..	24
1887	6	7	..	..	13
1888	2	1	..	2	5
Uncertain	2	22	..	39	63
Totals	22	100	1	45	168
"Certain" tot'l	20	78	1	..	99

figures, it is still quite apparent that the growing preference for steel which has prevailed in other classes of construction for the past few years has also largely controlled the construction of stand-pipes. No record of the number of stand-pipes built since 1888 is available, but it has recently been stated that there are now seven or eight hundred stand-pipes in the United Sates, and their number is rapidly increasing." If, as estimated, the stand-pipes, 163 in number, listed in 1888, were about one-half the total number, there were at that time perhaps 350 such structures in the United States, which indicates that the number has doubled in a period of about six years.

A complete record, brought up to date, along the lines suggested by Table X. seems at first thought to be much needed, but in reality the value of such a record would be largely nullified by the fact that the mere name, steel or wrought iron, is after all of little value as a measure of quality, notwithstanding a popular belief to the contrary. It is at this time highly important to give due consideration to a very significant effect upon the quality of wrought iron, which has been a direct result of the recent marked preference for steel in structural work. With the decline in the use of wrought iron, the reduced attention to its manufacture has led to such serious deterioration in quality as to even suggest that the superior past record of wrought iron in stand-pipe construction might soon be appreciably affected, or perhaps even reversed, in the event of a sudden resumption of the earlier preference for that metal for this purpose, unless a corresponding restoration of its former excellent quality was at once brought about. But with the present decided preference for steel in other classes of structural work, based largely, as it is, upon much reduced prices, and with the constant decline in the output of wrought iron as compared with steel, the probability of an exception being made in a single class of structures is very remote. If, as indicated by the meager statistics above given, the number of stand-pipes has been doubled within a period during which a decided preference has been shown for steel, it is probable that the contrast in the record of failures will continue to favor wrought iron, for, while many stand-pipes have been built with steel of suitable quality, a very considerable number have been constructed from "tank" steel. The latter grade of steel has perhaps led to a majority of the failures of steel stand-pipes and, because of its extended use in the past, will doubtless cause many others. The tensile strength of "tank" steel is frequently higher than is required, but its brittleness and low ductility render it liable to damage in the process of punching and sudden failure is apt to take place, particularly at low temperatures.

The use of an inferior grade of steel is, as a rule, the result primarily either of deficient or defective specifications, or in case proper quality and efficient tests are specified, the tests are omitted. The former is much too often the case, for even in the better practice it is by no means uncommon to find specifications for plate metal which merely fix the tensile strength with no reference whatever to other equally essential physical properties; or if tests are mentioned, their character is often such as to admit grossly defective material even if rigidly enforced. Loose specifications and methods of construction are also sometimes the outcome of a tacit understanding between a construction company and the contractor, by which a considerable saving is effected in the first cost of the stand-pipe at the expense of safety. As long as such practices are persisted in there is little hope for reform, and the stand-pipe will more and more become a menace to the very interests that it was designed to promote.

It is unquestionably practicable to construct a stand-pipe, either of steel or of wrought iron, which will be as safe as any other structure built from the same metal, provided like care is taken both in the original design and construction, and also in the subsequent operation and maintenance. However excellent the method of design and construction may be, it is, of course, vitally important to provide protection for the structure under certain critical conditions which have been described in the record of failures. The most critical of the emergencies which may occur in the life of a stand-pipe have been described in connection with the discussion of "ice" accidents. A clear conception of those emergencies leads to the belief that stand-pipe shells may be subjected to strains at least equal to, and probably at times much exceeding, those which may occur in the shells of high-pressure steam boilers. Adding to this the well-known treacherous action of steel of a brittle character (particularly high phosphorous steel) under low temperatures, the conclusion is reached that the standards of quality, both of material and workmanship, which govern high-grade boiler construction, should also prevail in the construction of stand-pipes. This standard, or its equivalent, has already been adopted by the more enlightened and progressive engineering practice, the tests of quality being based upon the actual conditions in the structure, and being so conducted as to afford conclusive evidence of the quality. It is scarcely necessary to remark that the responsibility of the designing or consulting engineer with respect to the enforcement of the proper quality of design, material and workmanship, should not be construed to cease with the completion of the structure. Considering all phases of the question, it seems proper to conclude that future practice may wisely continue to favor the use of steel in stand-pipe construction, provided the actual conditions to which the structure may be subjected are clearly recognized, and also that the details of the design, the grade of steel, and the class of workmanship, which will most effectually meet those conditions, are utilized with intelligence.

Returning to the discussion of Table IV., three cases of elevated wooden tanks whose failures were due to bursting hoops, suggested the need of cau-

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tion in adjusting the tension of the hoops to stop the leakage, on account of the increased strain caused by the swelling of the staves. In the absence of definite knowledge as to the dimensions and quality of the hoops, the true source of weakness cannot be assigned, but it is very probable that the usual errors of detail in the joints were not lacking. The scope of this record was not extended to include the failure of wooden railway tanks, of which a number have taken place, because of the fact that the three cases which have been described fully present the more common elements of danger encountered in the use of this type of tank.

The failure of the concrete footings under the supporting columns of the Lexington stand-pipe forcibly suggests the danger due to unequal settlement of isolated pieces of masonry, particularly where the presence of water may soften the substratum. This failure and those of the two brick towers urge the need of proper methods both in the design and in the construction of this class of masonry.

Before considering the next table, reference should be made to the characteristic phenomena which accompany the failure of relatively tall stand-pipes in which the initial fracture occurs near the base, as exemplified by the ruins themselves. A careful study upon the latter basis develops the fact that the stand-pipe is usually separated into three principal portions, viz.: (1) the foundation and bed-plate, generally left undisturbed except as to cuts and bruises in the latter, which are caused by falling plates; (2) a more or less demolished mass of plates, consisting usually of less than the lower half of the stand-pipe, and which, in general, is projected in a direction diametrically away from the point of initial rupture; and (3) the remaining upper portion which topples in the approximate direction of a radial line passing through the point of first rupture. In addition to the above, isolated fragments which are frequently projected to considerable distances, may offer important suggestions as to the point of first failure. It should be remarked that the second observation, or rather a modification of this observation as above stated, may often serve as available evidence in relation to the quality of plate metal, for when the metal is unusually brittle, it is found that the lower portion of the structure bursts into a number of individual fragments of large size, instead of clinging together as above stated. An exception to the third also has been observed in one case in which the direction taken by the unruptured top portion was sensibly modified by the action of the wind.

Table V is a special record of the six cases due to wind action, of which four were of steel and two of wrought iron, as shown in Table IV. The opinion seems to be entertained in some quarters that special anchorage is not necessary, except perhaps in the case of tall stand-pipes having small diameters. If this idea is based upon the belief that the empty tank has sufficient weight to counteract the wind moment, it is certainly not confirmed by the East Providence accident, where, with an unusually heavy structure, the force of the wind was strong enough to sensibly lift the windward side; and, furthermore, a similar occurrence has been observed in the Eastern States with other stand-pipes for which no anchorage had been provided. Or, possibly, the above mentioned practice assumes that the probability of having an empty stand-pipe and a severe wind storm simltaneously is too remote to require special provision. Such assumption finds no support in the record, for it is a significant fact that nearly one-fourth of the entire number of accidents which have been described have occurred during violent wind storms, and that, with one exception, the stand-pipes were entirely empty. On the other hand, it may be noticed that the structures actually overturned were in but two out of the five cases of entirely empty stand-pipes, although two others (Plattsmouth and East Providence) rocked with more or less violence upon their foundations. Of the four stand-pipes whose bearings were thus disturbed, three were anchored, a fact which urges the need of making the anchorage more secure. In this connection reference should be made to the undoubted advantages which may be had by the use of well designed bracket anchorages in the case of tall stand-pipes of small diameter. This necessity for a rigid connection between the stand-pipe and its foundation is by no means confined to the tendency to overturn, for it also bears an important relation to the vibration of the structure, which may lead to the collapse in the upper portion. Thus, for example, it is a matter of some doubt whether the stand-pipe at Plattsmouth would have collapsed had its anchorage remained firm, and in the case both of Kankakee and East Providence the vibrations of the plates were doubtless aggravated by the rocking too and fro upon the foundation.

In considering the question of overturning and collapse of stand-pipes, it would, at first thought, seem very important to know the actual velocity of the wind at the moment of failure, but aside from the interest in the figures as a part of the record, they are not of great utility; for, as a matter of fact, the danger to the stand-pipe probably depends less upon the actual intensity of the wind pressure than upon the accumulation of force by coincidence of gusts of wind with the vibrations of the tank. To the latter condition probably more than to anything else may be ascribed the failures to reach practical results in the various attempts which have been made to place the above problem upon a theoretical basis. The idea has been advanced that collapse is partly due to rarefaction of the air within the stand-pipe, but even if the difference in pressure were sufficient to have appreciable influence, it would seem to be secondary in importance to the vibratory tendency above mentioned. Considering this uncertainty, it is not surprising that there has been much lack of uniformity in providing stiffness in the upper portion of the stand-pipe; for, as a rule, the minimum thickness of plates and the dimensions of the stiffeners are fixed either by precedent or according to the judgment of the designer.

Table V. also shows that collapse took place in five out of the six cases and that, with one exception, the stand-pipes were entirely empty. In the case of the Victoria collapse, in which only the empty portion failed, the storm was of unusual violence, but the occurrence shows that safety against such an accident may be had only with a full stand-pipe. It is also a striking fact that four of the six accidents occurred either during construction or in the interval between completion and first test, a critical period which must of necessity occur with every stand-pipe. It would seem that the system of floating derrick construction, used with success in a number of instances, is admirably adapted to the needs above mentioned, although its original adoption and subsequent use have, of course, been based upon a quite different requirement. Thus, for instance, in the case of the East Providence stand-pipe, had the contractor used a floating derrick (as the sub-contractor for the roof of the same structure is said to have done) the collapse of the upper portion and, under the circumstances, perhaps the final failure as well, would have been obviated.

TABLE VI.—Classification of Total Failures with Reference to Life of Stand-Pipes.

Failed previous to test.	Failed during test.	Failed after test.	Life.	Summary.
Kankakee....W. I.	Cleveland....W. I.	Jersey City....W. I.	10 years.	Steel..... 9
	Cincinnati... S.	Franklin..... M.	4 weeks.	Wrought iron..... 3
	Lexington.... M.	Seneca Falls.... S.	4 mos.	Wood..... 3
	Gravesend.... S.	Defiance..... S.	2 years.	Masonry..... 2
	Newport..... W.	Asheville..... S.	6 "	
	Temple..... S.	Maryville..... S.	6 "	
	Nappanee.... W.	E. Providence... S.	4 mos.	
	Wheatland... W.	Peoria..... S.	4 years.	
Total..... 1	Total..... 8	Total..... 8		Total..... 17

TABLE V.—Special Record of Stand-Pipe Accidents and Failures due to Action of Wind.

Name.	Caldwell.	Victoria.	Kankakee.	Asheville.	Plattsmouth.	E. Providence.
Diameter, feet.....	12½	16	20	45	25	40
Height.....	150	100	124	60	80	120
Kind of plate metal.....	Steel.	Wrought iron.	Wrought iron.	Steel	Steel.	Steel.
Existing conditions.....	During const'n: empty.	Top 30 ft.; empty.	Just completed; empty.	Just completed; empty.	During repairs; empty.	During const'n; empty.
Manner of failure.....	Overturned.	Collapsed.	Collapsed and overturned.	Collapsed.	Collapsed and anchor bolt broke.	Collapsed.
Thickness of plates in collapsed portion.....	.....	30 ft., 3/16 in.	24 ft., ¼ in.	20 ft., ¼ in.; (?) ft., ⅜ in.	24 ft., 3/16 in.; 8 ft., 7/32 in.; 8 ft., ¼ in.; 8 ft., 9/32 in.; 4 ft., 5/16 in.	20 ft., 5/16 in.; 15 ft., ⅜ in.
Top stiffening angle.....	(?)	(?)	3 × 3 × ½ ins.	3 × 3 × ⅜ ins.	2 × 2 ins., punched.	None.
Anchorage.....	Guys.	Brackets.	6, 1½-in. bolts.	None.	4, 2-in. bolts.	None.
Probable max. vel. of wind miles per hour.....	?	80	60	(?)	70	60

Aside from the facts presented in Table V. an important effect of the wind in the case of tanks of large diameter should here be mentioned. Referring to the descriptions of the Cincinnati, Asheville and East Providence failures, it will be found that the tanks, having diameters of 100 ft., 45 ft. and 40 ft., respectively, are believed to have been weakened by the continuous vibratory action of the wind upon the plates. In the first instance the tank had been exposed to the heavy winds for a considerable period during its construction and it failed in its first test; in the second case guys were added after visible damage from the same cause some two years before the final failure took place under ice strains; and in the last named case the sides had been violently vibrated during a series of wind storms while empty during construction about 4½ months previous to the final failure.

It is, of course, needless to say that, in the main, the above observations do not apply to tanks which are encased in masonry or are otherwise effectually protected from the direct action of the wind.

The classification of total failures in Table VI. is made with reference to the life of the stand-pipe, that is, as regards the relative times of first test and of failure. It will be noted that one failure occurred previous to test and that eight failed during test. In the remaining eight failures the life varied from four weeks in the case of the brick supporting tower at Franklin to ten years in the Jersey City stand-pipe, and was six years in two other cases. This leads to the important observation that no assurance of safety is to be found in the mere fact that any given stand-pipe has stood for several years without visible signs of weakness. Reference has already been made to the contrast in the number of steel and wrought iron stand-pipes which have failed totally; this fact is also shown in Table VI. in the summary column.

Tables VII., VIII. and IX., class the accidents with reference to existing conditions and extent of damage in connection with location by state, date by month and date by year, respectively.

Table VII. presents the fact that the distribution of accidents under each cause has been quite general. Perhaps the most striking feature of this table is the failure due to ice strains as far south as North Carolina, the explanation of which may be found in the high altitude of Asheville, where the accident occurred. It is also of interest that four of the six accidents due to wind pressure have occurred in the West.

Table VIII. shows that the number of accidents which have occurred in the month of October is greater than that of any other month, but, by tracing the record of the six cases, it is found that two of the accidents occurred during first test and a third previous to test, so that the excess in October is due to the fact that several initial tests have chanced to be then made, and not because the conditions have been actually more severe during that month. It is also seen that all the wind accidents have taken place from March to October, inclusive, and that the ice accidents have been practically confined to January, February and March, the one ex-

eption having occurred on Dec. 31. Since the water accidents have occurred mainly during first test nothing of special interest concerning them is shown in Table VIII.

Table IX., giving the date by year, is chiefly of interest in a historical sense, the most striking feature being the well-known epidemic of stand-pipe accidents and failures which took place in 1886 and 1887, the largest number, six, having occurred dur-

TABLE VII.—Classification of Stand-Pipe Accidents and Failures with Reference to Location by States.

	Existing conditions and extent of damage.								Summary.			
	Water.		Ice.		Wind.			Other.				To-
	T.	P.	T.	D.	T.	P.	D.	P.	T.	P.	D.	tal.
Arkansas	1	..	..	..	..	..	..	..	1	..	..	1
Georgia	..	..	..	..	..	..	..	1	..	1	..	1
Illinois	1	..	..	..	1	..	..	..	2	..	..	2
Indiana	1	..	..	1	..	..	..	..	1	..	1	2
Iowa	..	..	1	..	..	..	..	..	1	..	..	1
Kansas	..	..	..	..	..	1	..	..	..	1	..	1
Massachusetts	1	..	..	..	..	..	..	..	1	..	..	1
Missouri	1	..	1	..	..	..	..	..	2	..	..	2
Nebraska	..	..	..	..	..	..	1	..	..	..	1	1
New Jersey	..	..	1	..	..	..	..	..	1	..	..	1
New York	2	..	..	..	..	..	..	..	2	..	..	2
N. Carolina	..	..	1	..	..	..	1	..	1	..	1	2
Ohio	2	2	1	1	..	..	..	..	3	2	1	6
Rhode Island	..	..	1	..	..	..	1	..	1	..	1	2
Texas	1	..	..	..	..	1	..	..	1	1	..	2
Wisconsin	..	..	..	1	..	..	..	..	..	..	1	1
Totals	10	2	6	3	1	2	3	1	17	5	6	28

T denotes total failure, P, partial, and D, slight damage.

ing the latter year. It is also seen that four cases occurred in 1893, equal in number to those in 1886, although it should be noted that the greatest number of total failures within a year is three, there having been this number both in 1887 and 1893. Attention has already been drawn to the startling fact that of the six total failures which have taken place in the presence of ice four have occurred in 1893 and 1894.

In conclusion, it seems proper to mention the sev-

TABLE VIII.—Classification of Stand-Pipe Accidents and Failures with Reference to Date by Month.

	Existing conditions and extent of damage.								Summary.			
	Water.		Ice.		Wind.			Other.				To-
Month.	T.	P.	T.	D.	T.	P.	D.	P.	T.	P.	D.	tal.
January	..	..	3	1	..	..	..	..	3	..	1	4
February	..	..	1	1	..	..	1	..	2	..	2	4
March	1	..	1	1	..	..	1	..	1	..	1	2
April	..	..	..	..	..	..	1	..	..	..	1	1
May	1	..	..	..	..	..	..	..	1	..	..	1
June	2	..	..	..	..	1	..	..	2	1	..	3
August	1	..	..	..	..	1	..	..	1	1	..	2
September	..	..	..	..	..	..	1	..	..	..	1	1
October	4	1	..	..	1	..	..	..	5	1	..	6
December	..	..	1	..	..	..	..	1	1	1	..	2
Unknown	1	1	..	..	..	..	..	..	1	1	..	2
Totals	10	2	6	3	1	2	3	1	17	5	6	28

T denotes total failure, P, partial, and D, slight damage.

eral lines of apparent need for reform suggested by the foregoing record. While the maximum attainment of safety must continue to come through the rigid and intelligent enforcement of high quality, both of material and workmanship, the element of design also offers a broad field for improvement. The question of quality is provided for in the strict system of test and inspection which govern other classes of structural work, and too much stress cannot be placed upon the rigid enforcement of proper-

TABLE IX.—Classification of Stand-Pipe Accidents and Failures with Reference to Date by Year.

	Existing conditions and extent of damage.								Summary.			
	Water.		Ice.		Wind.			Other.				To-
Year.	T.	P.	T.	D.	T.	P.	D.	P.	T.	P.	D.	tal.
1868	1	..	..	..	..	..	..	..	1	..	..	1
1869	..	..	1	..	..	..	..	..	1	..	..	1
1877(?)	..	1	..	..	..	..	..	..	..	1	..	1
1878	..	1	..	..	..	..	..	..	..	1	..	1
1881	1	..	..	..	..	..	..	..	1	..	..	1
1885	1	..	..	..	..	..	..	..	1	..	..	1
1886	1	..	..	..	1	2	..	..	2	2	..	4
1887	3	..	..	..	..	..	2	1	3	1	2	6
1889	..	..	..	1	..	..	..	..	..	..	1	1
1890	1	..	..	..	..	..	..	..	1	..	..	1
1891	..	..	1	2	..	..	..	..	1	..	2	3
1892	1	..	..	..	..	..	..	..	1	..	..	1
1893	..	..	3	..	..	..	1	..	3	..	1	4
1894	1	..	1	..	..	..	..	..	2	..	..	2
Totals	10	2	6	3	1	2	3	1	17	5	6	28

T denotes total failure, P, partial, and D, slight damage.

ly worded specifications. Probably the most urgent need for improvement in design is suggested by the large number of total failures which have occurred under the two heads of water and ice. A consideration of the liability of the more common type of stand-pipe to fail near its base, in connection with the matter of effective storage, first led to the use in this country of the elevated tank. Subsequent consideration of the elements of economy of construction and, in some instances, of architectural effect, has led to modifications of form in the supporting framework or tower, and also, to a limited extent, to the adoption of the several types of tank bottom, which originated in the German practice. In addition to the above questions there also seems to be room for improvement in the method of construction. In the latter connection the floating derrick system, which has already been mentioned, seems particularly promising in view of the large number of total failures which have occurred under hydrostatic pressure during first test; for, as is well known, a flaw which may prove fatal under a suddenly applied load might either be detected or prove harmless under the same strain gradually applied. The danger from ice suggests the need of measures to prevent its formation, to which end the simplest and best device, although often expensive, is the enclosure of the tank, leaving an air space to secure insulation (this expedient has recently been applied with success to several exposed stand-pipes which had previously been endangered by ice formation). Although this plan entails a considerable increase of cost, it has an advantage which is too often overlooked in that it affords a means of providing for the architectural effect in a manner superior to the metal cylinder. The elements just mentioned may often be served in an efficient manner by the use of a roof which, besides reducing the tendency to form dangerous ice caps, will also exclude the direct rays of the sun, the influence of which upon some water supplies in promoting vegetable growths so as to cause objectionable tastes and odors in the stored water, is well known. It is important, however, to consider the possible danger to the roof and perhaps to the entire structure in those localities where ice forms in excessive quantities, by the buoyant tendency of the mass of ice after it has melted loose. Still another advantage in the use of the roof may be found in those cases of low tanks which may be accessible to mischievous parties as receptacles for polluting matter of various kands, although the large diameters of many such low-level storage tanks may suggest the use of a less expensive means of abating such a nuisance. The necessity for excluding all obstructions from the interior of the stand-pipe, which has already been discussed, is easily provided for in making the design. The wind accidents, as already stated, suggest the need of firm anchorage and also urge liberal provision for rigidity in the upper portion of the stand-pipe. The latter consideration may, as a rule, be provided for in ordinary cases by using plates of reasonable thickness, but as the diameter becomes large the thorough protection of the structure while empty seems to demand the use of guys or an equivalent means of reducing the vibrations due to wind. A consideration of the latter element in connection with the uncertainties of quality which exist in excessively thick plates suggests that a recent tendency toward the combination of a large diameter and a considerable height in the same stand-pipe is not wise, although such a design may sometimes be necessary. Recent tests of riveted joints in soft steel plates have strikingly shown the damage resulting from punching rivet holes in thick plates and some engineers have been led to specify that all plates above $\frac{3}{4}$-in. in thickness shall be drilled, or if punched that the holes shall be reamed, and one recognized authority has also taken into consideration the change in character of the fracture due to the punching and has placed the limit at $\frac{1}{2}$-in. (an examination of the table of stand-pipes in the United States in 1888, already mentioned, shows that of 136 cases in which the thickness of the first course of plates is stated, in only 13 (or 10%) of them did the thickness reach $\frac{3}{4}$-in. and of the latter in only five cases was that thickness exceeded.) It is also quite generally believed that $\frac{7}{8}$-in. or 1-in. is the maximum thickness of plate which can be satisfactorily riveted up by hand in the field and such a limit should be observed in the stand-pipe design. In addition to the questions of design and construction that of operation also deserves attention, particularly in the presence of ice in large quantities. Under the latter conditions the necessity for frequent pumpings during severe freezing weather and for avoiding low stages of water during a thawing period should be clearly recognized and provided for.

While many points of interest have doubtless been presented in the foregoing record and classification, the real value of the inquiry must, of course, be measured by the light which it may afford for the guidance of future practice. If the latter end has been accomplished in even a slight degree the effort of the writer will be amply compensated.

Note.—In the last previous article of this series (May 24, near middle of first column, p. 423) a typographical error reverses the meaning intended for the parenthetical statement relative to the influence of porosity on the action of ice in stand-pipes, the word insensibly being substituted for sensibly. With this correction the statement becomes:

> It should here be stated that it has been found by careful experiments, that the plasticity of ice is sensibly increased by the presence of air bubbles, such as exist in the ice which usually forms in stand-pipes, and it is also of importance to note in the same connection, that the plasticity of ice is considerably greater at and very near the freezing point than at lower temperatures.

The importance of the above correction lies in the fact that the plasticity of the more or less porous ice tube formed within the metal shell has doubtless been the direct means of preventing many stand-pipe failures. Various experiments made primarily for the purpose of throwing light upon glacial action also have an important bearing in this connection. The results of the more reliable of these experiments have appeared in "Nature" from time to time, reference to which is made as follows: Vol. I., p. 534; Vol. IV., p. 447; Vol. VI., p. 396; Vol. VII., p. 287; Vol. XII., p. 317; Vol. XXXI., p. 329; Vol. XXXII., p. 16, and Vol. XLII., p. 213.

The above reference to Vol. XXXII. of "Nature" is of particular value in that the writer, Morgan, reviews previous experiments besides giving the results of his own tests of the "viscosity" of ice. In the reference to Vol. XLII. (abstract from the "Royal Society Proceedings") the experimenter, Andrews, concludes that "if the plasticity of ice at $-35°$ F. be taken as unity, that at $0°$ F. $= 2$, and at $28°$ F. $= 8$." From the last named temperature up to $32°$ F. this property must increase very rapidly, for Prof. Pfaff had previously (1875; see "Nature," Vol. XII. p. 317) found "that even the smallest pressure is sufficient to dislocate ice particles if it act continuously, and if the temperature of the ice and its surroundings be near the melting point."

If the above-mentioned relation between porosity and plasticity of ice be considered in connection with the well-known prevalence of air bubbles (frequently in large quantities) in freshly pumped water, important light is thrown upon the failures of the Asheville, N. C., and the East Providence, R. I., stand-pipes, for in both instances the quality of the ice tubes must have been exceptionally dense, and hence unyielding, because of the fact that pumping had not been in progress during the period of ice formation.

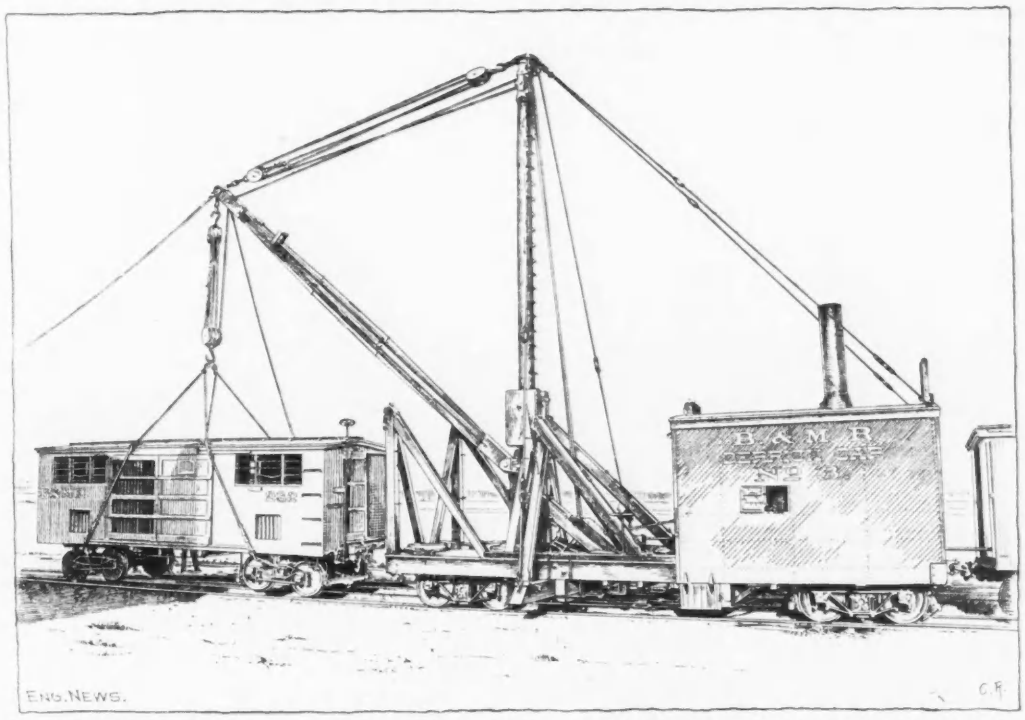
PAINTS FOR IRONWORK.

At a recent meeting of the Association of Engineers of Virginia, Mr. Samuel Wallis read a paper on the subject of paints and painting, from which we make the following extract:

> For painting ironwork he recommended a first coat of pure red lead (in powder), and raw oil, to be used within two or three weeks after mixing, and to be kept thoroughly mixed while using. It will dry in from 24 to 30 hours. The red lead should be ground in a mill if possible immediately before using.
>
> If the finish is to be black, use two coats made from a paste consisting of 65% pigment and 35% raw oil, the pigment to consist of 65% sulphate of lime, 30% lampblack and 5% red lead as a dryer. The whole thinned to a proper consistency with pure boiled oil. This paint ready for use will cost about 65 cts. per gallon.
>
> If the finish is to be in red or brown, use a paste consisting of 75% pigment and 25% pure raw oil, the pigment to consist of 55% sulphate of lime, 40% oxide of iron free from sulphur and caustic substances, and 5% carbonate of lime as a dryer, the sulphate of lime to be fully hydrated. This paint will cost ready for use about 60 cts. per gallon.
>
> Lead paints are not recommended for finishing coats on account of chalking, neither is zinc, on account of cracking. Graphite paint does not dry well in linseed oil, and is not impervious to water. The color is steel gray. Both white and red lead should be thoroughly tested for purity.

RAILWAY WRECKING TRAINS.

The exigencies of railway operation and the necessity of removing train wrecks and repairing washouts, etc., with the least possible delay, so as to keep the road open for traffic, render it necessary for every railway to keep in readiness for immediate use "wrecking trains" equipped with cranes, tools and appliances for clearing the track or building temporary structures. The wrecking train, therefore, is a highly important part of the operating plant of a railway, and upon the proper equipment of the train and the proper organization and handling of the wrecking gang depend in great measure the promptness, efficiency and economy of the work of clearing the track after a train accident or providing temporary connections at washouts, landslides, etc. It is not sufficient to have a lot of old tools and miscellaneous supplies stored in a tool car, but the equipment must be of good serviceable material, including tools and supplies for every kind of work, and these supplies must be neatly and systematically arranged where they can be got at easily and quickly. One of the most important appliances for the wrecking train is a derrick car or steam crane capable of lifting cars or even engines bodily, thus avoiding the necessity of having to smash up the wreckage in order to remove it from the track. The number of these



35-TON DERRICK CAR FOR WRECKING TRAIN; BURLINGTON & MISSOURI RIVER R. R.

trains and the length of division to which each is allotted, necessarily vary with the importance and amount of the traffic. The methods of operation will vary in each case, in accordance with the nature of the accident and the work to be done, but while in case of train wrecks it is generally of the first importance to remove the wreckage as quickly as possible from the track, so that provision can be made to carry on the traffic, this should not be done recklessly by the smashing up and throwing aside of cars or other equipment which may with a little care and clearheadedness be moved aside out of the way for future attention. For this reason the powerful derrick or crane is a most economical wrecking tool. As already noted, the equipment and operation vary according to the traffic over the road and the nature of the accident, but we present herewith the particulars of equipment of wrecking train and organization of wrecking gang on several roads, from which may be obtained a very good idea of the general practice.

Burlington & Missouri River R. R.—On this road the practice is to have regular wrecking outfits at main points, and also smaller outfits stationed at outside division points at long distances from the main points where regular wrecking outfits are stored. The smaller outfit consists of blocking, jacks, rope, etc., loaded in two box cars that could be got to a wreck promptly and track cleared or constructed around the wreck. Then as soon as possible a regular wrecking outfit is sent out and the wreck picked up with as little loss to property as practicable. The regular wrecking cars consist of a common wooden oak mast and boom mounted on a strong car made especially for that purpose. The mast is about 14 ins. in diameter in the center and 37 ft. high above the car bed, pivoted 18 ft. above the rail at the top of a strong stand, so that it can be lowered down and laid on top of the car, together with the boom, when in transit and not in use. The boom is of the same length and size as the mast, except that it is trussed with 1-in. rods on the sides. It is of sufficient length and height to pick up a loaded 34-ft. box car and place it on its truck in front of the derrick, as shown in the accompanying cut.

The mast is made from oak piling and has to be renewed occasionally, but the expense of doing this is very small, as selected piling is taken and is fitted up with very little work.

The derrick is provided with heavy base timbers mounted with channel irons, placed on rollers under the car bed in such a way that they can be pulled out and blocks put under the ends, and this with a strong brace from the end of this timber to the top of the mast stand, makes the base very wide and firm. When heavy lifting is done, guy lines are run out from the top of the mast to anchors or deadmen in the ground a sufficient distance away for good effect.

The power is derived from one double oscillating engine with cylinders 10 × 12 ins. acting on friction drums and spools with slow and fast motion, as may be desired. The derrick is rated at 35 tons capacity, but heavier loads have often been handled. This derrick enables the gang to take loaded cars that are off the track or have trucks smashed, and set them out on one side, and work right through a wreck and clear the track, setting material to one side without breaking cars or wreckage any more than necessary. Then later on they pick up the stuff and put it back on the track, or load on cars such wreckage as cannot come out on its own wheels.

The plan of organization of the gang is to have the car repairing crews at the main division points organized as a wrecking gang. These men sleep in a car attached to the wrecking train, and are always ready for duty, either during working hours of the day or sleeping hours of the night. The foreman, who sleeps at home, is connected with the dispatcher's office by telephone. When the derrick is run out to a wreck, each man gets to his position immediately. The boom and mast are raised, guy lines run out and the work of clearing the track begins. The time taken in getting everything ready is about 20 minutes. There is one man at the engine, one man in front of the drums, and one man at back of the drums to take care of ropes, one man on the deck in front of the derrick to receive signals from the foreman and give them to the engineman by the bell, and two men in the rope car next to derrick, making seven men in all, besides the foreman.

There are no special rules in regard to handling the work, except that if a wreck occurs after regular working hours (which are from 7 a. m. to 6 p. m.), the shop whistle is blown six times to call the men together in case they should be away from the sleeping car. This is repeated two or three times.

The wrecking train consists of one derrick car, three tool cars, one riding car and one sleeping car. The riding car is used by the men in going to and from wrecks, and to dry their clothing in when wet. The last car in the train is a sleeping car made over from an old passenger car, and has sleeping capacity for 24 men. It has iron bunks (single on one side of car and double bunks on the other), steel spring mattresses, wash sink, water closet, and a stove at each end.

Chicago & Eastern Illinois R. R.—The wrecking train consists of one steam derrick of 70,000 lbs. capacity; one coal car for blocking and boom reach; one flat car with six sets of freight car trucks, eight steel rails, bolts and splices; one box car for ropes, blocking, chains, jacks, tools, etc., and a telegraph office equipment; and one boarding car. The crew consists of foreman, derrick engineman, fireman, two machinists in case of engine wreck, one rope man, one crane man, one tool man, one cook and eight car repairers, or 17 men in all. On the C. & I. C. Division the outfit consists of a 15-ton hand derrick and tool car, with a gang consisting of foreman and eight men. When this crew goes to a wreck it takes the boarding car and bridge tool car, using bridge tools in case of necessity.

East Tennessee, Virginia & Georgia Ry.—Mr. D. W. Lum, Chief Engineer, writes that this road has about 1,800 miles of track, divided into six divisions, the headquarters of each being supplied with a tool and derrick car with wrecking outfit. These cars are under the charge of a man who is under the direction of the Master Mechanic and who is supposed to keep everything in good order and to serve in the Car Department when not required on the road with his tool car. The wrecking cranes range from 10 tons to 20 tons capacity and the tool cars are equipped with jacks, bars, blocks and ropes, lanterns and Wells lights, spikes, bolts, extra rails and switch points. In case of accident the Roadmaster, if available, takes general charge, the tool car man having charge of the work in detail.

Louisville, New Albany & Chicago.—Mr. F. Hall, Chief Engineer, states that the principal operation for wrecking on this road is, if a freight train, to clear the track the first thing, even at the expense of further demolishing the cars. No cranes are used for picking up engines, but the work is done entirely by lines and jacks. Small derrick cars only are used for picking up the broken freight or material and wreck. In each case the outfit consists of the derrick car, one or two gondolas with trucks, extra wheels and blocking; one other car, usually an old baggage car fitted up, in which are carried lines, clothing supply and places for the men.

Norfolk & Western R. R.—Mr. C. S. Churchill, Engineer of Maintenance of Way, states that the system in force on this road requires a force of men known as the wrecking force to be located at each of the division points. They are in charge of the Conducting Transportation Department and are employed about the division shops when not on duty at wrecks. The wrecking train consists of a wrecking or derrick car, cabin car and car containing general supplies. The practice in the matter of wrecking train equipment conforms closely with that of other roads.

Pennsylvania R. R.—Mr. F. L. Sheppard, General Superintendent of the Pennsylvania R. R. Division, writes that the wrecking trains are composed of tool car, derrick car, and such maintenance of way flat cars as may be necessary. Single derrick cars have derricks of five to fifteen tons capacity, while double derrick cars have two 15-ton cranes. The wrecking gangs are in the immediate charge of the conductor of the work train, who, as a rule, is also foreman of the wrecking gang. The Supervisor or his assistant is usually in attendance at wrecks of any importance. The

custom is to assign men in the gang to handle certain tools, the detail of the work being in charge of the Supervisor or of the foreman of the gang. The Wells light is used in night work. The following table gives a list of the equipment of the wrecking trains:

Wrecking Equipment Maintenance-of-Way Tool Car, Pennsylvania R. R.

10 pieces of blocking,	7 × 8	ins. ×	5 ft.	7 ins.
8 " " "	7 × 8	" ×	2 "	9 "
12 " " "	7 × 3¾	" ×	1 "	10 "
50 " " "	7 × 8	" ×	5 "	7 "
12 boards, hard wood	6 × 1¾	" ×	1 "	6 "
12 wedges, hard wood	3½ × 4	" ×	1 "	8 "
1 rope, 1¾-ins. diam.,	300 ft. long, 2 and 3 sheave blocks			
1 " " "	200 " " " " "			
2 tank ropes, 2½-in. diameter,	60 ft. long.			
2 " " "	"	30 " "		
2 " " 2-in.	"	30 " "		

4 patent chains.	2 patent frogs.
4 truck chain.	4 pinch bars.
6 dog chains.	2 claw bars.
3 truck connections.	1 spike hammer.
2 pulling bars.	2 sledges.
4 fire buckets.	4 jack braces.
2 ropes, ¾-in. for fire hooks.	4 jack hooks.
1 snatch block.	1 auger, 2½-in.
2 grappling irons.	1 " 2-in.
2 fulcrums.	1 " 1½-in.
1 track gage.	1 " 1¼-in.
½ coil telegraph wire.	1 " 1-in.
2 large levers.	2 handsaws.
2 small "	1 axe (hand).
2 fire hooks.	1 soft hammer.
1 wooden mallet.	2 iron hammers.
1 ratchet.	2 monkey wrenches, 14-ins.
2 drills, 1 in.	2 " " 20-ins.
2 small vices for splicing wires.	1 carpenter's chisel, 1-in.
	1 " " 2-ins.
1 pair telegraph climbers.	6 chipping chisels.
6 coupling pins.	2 files, 14-in.
6 coupling links.	1 wheel gage.
4 coupling links (crooked).	2 wash basins.
4 body pins, 1¾-ins.	2 pole axes.
2 draft pins.	6 torches.
2 short 15-ton jacks.	8 white globe lamps.
2 long 15-ton "	2 red " "
2 " 10-ton "	4 side lamps.
1 broom.	1 sponge hook.
4 dusting brush.	16 clay shovels.
6 oil cans.	14 coal shovels.
6 boxes matches.	4 spades.
25 signal caps.	16 picks.
150 spikes.	4 cold cutters.
1 fire shovel.	1 soap box
25 three-bushel bags.	1 match box.
10 lbs. waste.	

Richmond & Danville R. R.—The financial conditions of this road have not been favorable to thorough and complete equipment, but Mr. Channing M. Bolton, Chief Engineer, writes that what he has aimed at is to have a wrecking train on each of the divisions, which are about 600 miles in length, to be equipped with about ten flat cars and caboose cars to accommodate about 30 laborers. The equipment for these cars should be about such as noted in Mr. Bolton's paper on "Emergencies on Railways" (Trans. Am. Soc. C. E., 1892), but of course varying with the peculiar necessities of the division for which it is equipped. The crane should be of capacity sufficient to lift any engine used on the division. He does not think it necessary to keep up a special wrecking gang always ready for service as such, but as soon as a wreck occurs the engineer of the division should be notified, going to the wreck as soon as possible, he can then order such wrecking equipments and gangs from his working trains, section forces or slop forces as he may deem necessary for the work. When the forces arrive at the wreck the engineer in charge should organize them for work, first arranging for his rations and cooking to be properly done, then if he sees it will take him longer than 12 to 15 hours' work, and he has sufficient force, it should be divided into a night and day gang; the force not at work to be kept entirely away from the work, resting and getting ready for their shift. As soon as the first gang has finished its time, the second should be ready to step in at once and so carry on the work uninterruptedly. If the force is not adequate to be so divided, then there will be much more accomplished if they are worked steadily through the day hours and then required to rest until day again. In this way it is found that much more is accomplished than by trying to push the same men through the night that have worked all day. The method for lighting for night work which he thinks would be best (as described in the paper above referred to) is by a car equipped with an electric plant, but not having this the Wells lights are the best substitutes, together with a few gasoline lights, such as are used at fruit stands in the cities; these answer to move to special places where lights are needed, the Wells lights being heavy and difficult to handle.

WATER PURIFICATION IN AMERICA.

(Continued from p. 386.—With inset.)

Aeration and Continuous Sand Filtration at Ilion, N. Y.

Sand filter beds operated on the continuous plan and with collecting drains similar to those used by one of the London companies were put in operation at Ilion, N. Y., on Sept. 30, 1893. The water is aerated before filtration by means of a fountain located in the storage reservoir. Ilion is a village in the central part of the state, which had a population of 4,057 by the census of 1890. Water-works were built by the village in 1893 and put in operation on or about the date named above. The whole system was designed by the Stanwix Engineering Co., of Rome, N. Y., and the construction was carried on under the personal supervision of Mr. J. W. Kittrell, a member of the company. The following description of the purification plant and of the supply system in general was written for this journal by Mr. Kittrell:

The village of Ilion, N. Y., is supplied by gravity with water taken from Hawk's Creek, a stream having, above the water-works intake, a drainage area of about six square miles, the larger part of which consists of cultivated farm lands. Barnyards and farm buildings are situated so near the stream at several points that it was thought desirable to filter the water, and the plan of continuous sand filtration was adopted.

The water is diverted from the stream into an intake chamber by a low dam, shown in detail by Fig. 1 on the inset sheet, which was raised above the natural channel only a little more than was necessary to turn into the chamber an amount of water equal to the maximum discharge of the pipe line connecting it with the storage reservoir.

An 8-in. gravity main, about 6,000 ft. long, conveys the water from the intake to a 15,000,000-gallon storage reservoir, the flow line of which is 190 ft. below the lip of the diverting dam. A plan of the storage reservoir, filter beds and clear water basin is shown by Fig. 2 on the inset sheet.

The usual discharge into the reservoir takes place through a fountain (Figs. 25 and 26) in the cap of which are set 70 ring nozzles, with diameters as follows: One ½-in., 6 ⅜-in., 14 ¼-in. and 49 3-16-in. The half-inch nozzle is in the center of the cap and discharges vertically; the others are set in four concentric circles, in the order of their diameters, the

Fig. 25. View of Aerating Fountain, Ilion Water Works.

axes of the nozzles in the successive circles being inclined at angles of 5, 10, 15 and 20° respectively, to the vertical. The maximum computed discharge of the fountain is a little less than 900,000 gallons in 24 hours, and the maximum observed height reached by the center jet is 90 ft. The water discharged is broken up into a multitude of small drops and falls into the reservoir in the condition of fine rain, so that aeration is very complete. A general discussion of this fountain and a similar one at Frankfort, N. Y., is given further on. During the winter months the cap is removed and the water discharges through the open end of the pipe, with the result of keeping a wide circle of open water and affording to the masonry fountain pier the necessary protection from ice. A second 8-in.

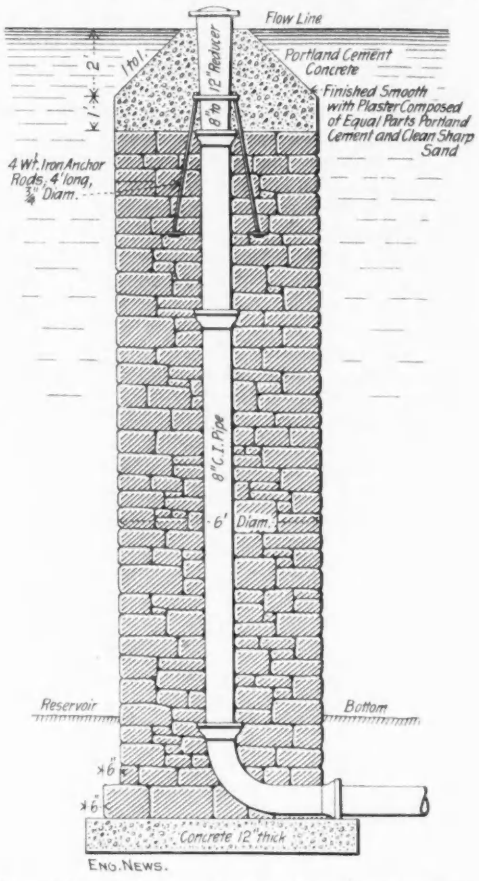


Fig. 26. Section of Aerating Fountain, Ilion Water-Works.

discharge pipe is laid into the reservoir and may be used independently or as an auxiliary to the fountain. A view of the fountain is shown by Fig. 25 and the details, without the nozzle, by Figs. 26 and 27. The top of the jet is also shown in the distance in Fig. 28.

The inner slopes of both main and side embankments are protected by 12-in. slope walls, the footings of which are nowhere less than 6 ft. below the flow line.

The main embankment was built entirely of material taken from within the reservoir flow line and was deposited in 6-in. layers, which were wet from the under side by sprinkling the made embankment ahead of each layer, and thoroughly rolled with a grooved roller weighing about 800 lbs. per lin. ft. The best material was used for building the inner half of the embankment, the poorer material, including the sod and surface soil, being used for the outer half. A puddle trench 8 ft. wide and extending everywhere into impervious material, but nowhere less than 6 ft. deep, was excavated under the inner half of the embankment, the line of excavation being such that the distance, measured at right angles to the slope, from the up-stream face of the bank to the up-stream edge of the trench was nowhere less than one and a half times the width of the trench. This rule was followed in ascending the side slopes of the valley until the center line of the trench coincided with the center line of the embankment, after which the center line of the trench was continued on the center line of the embankment. This trench was filled to the surface with clay puddle, which was required to be tempered in boxes and then cast with shovels into the ditch. Special care was taken by thorough rolling to make a good connection between the top surface of the puddle and the embankment over it. A 16-in. mud pipe and a 16-in. delivery main are laid under the embankment in ditches excavated in the natural ground to the average depth of 6 ft. To prevent leakage from following along the pipes the trenches were filled to the surface with clay puddle, and each pipe, at the point where it crossed the puddle

trench and midway between this and the inner toe, was fitted with cast iron disks of diameter 3 ft. greater than the outside diameter of the pipe, which were leaded and securely calked to the outside of the pipe and were surrounded by blocks of puddle. The puddle used in filling the pipe trenches and surrounding the disks was very carefully tempered with a minimum quantity of water and very thoroughly rammed into place. So far as can be determined by careful observation the reservoir is absolutely tight. The overflow from the storage reservoir is shown in detail by Fig. 3, on the inset, and Fig. 4, also on the inset, shows the special inlet basin and the beginning of the flood water ditch at the west end of the reservoir. The 16-in. delivery pipe conveys the water from the reservoir to the two filter beds, each having at the surface of the sand an area of 3,040 sq. ft.

Fig. 28 in the text is a view of the filter beds, clear water basin and gate house, showing the reservoir embankment and the top of the fountain jet in the distance. Figs. 5 and 6, on the inset, show the plan and details of the filter beds and clear water basin.

The walls of the filter beds are of rubble masonry, faced with heavy rock-faced ashlar from a point one foot below the surface of the sand. The bottoms of the beds are level and are covered with a 6-in. layer of concrete. Through the center of each bed two 12-in. brick walls, 18 ins. apart inside, were built to the level of the top of the sand, and each of the channels so formed was divided into two compartments by an horizontal partition of 4-in. flagstones, covered with a thin layer of concrete. The lower of these compartments is the main collecting drain, the upper being the distributing channel. The plan adopted for underdraining the sand is that designed by Mr. James Muir and in use in some of the filters built by the New River Co., of London, and consists of two courses of brick laid dry (see the sections, Fig. 5 on the inset), the bottom course being of brick laid end to end in lines at right angles to the main collecting drain, with spaces equal to the width of a brick between the lines; the channels so formed run through the brick walls into the collecting drain and are covered with a second course of brick, laid at right angles to the first and as closely as possible. This form of underdraining seemed best adapted to securing a uniform velocity through the sand, and, by making unnecessary the layers of coarse gravel and broken stone, permitted a considerable reduction in the depth of filtering material usual in such filters. Although such underdrains are more expensive than those usually employed, the construction as a whole is materially cheapened by reason of the reduced depth of the beds. Next above the dry brickwork was placed a 6-in. layer of pea gravel, and above the gravel 30 ins. of sand of as uniform a grade as could be obtained. The sand was screened and thoroughly washed with water under pressure; this washing was particularly valuable in removing nearly all of the very fine particles of sand and leaving it in a very uniform condition as to size of grain. No physical analysis was made for determining the size of grain, but a rough idea may be conveyed by describing it as a very uniform coarse mortar sand. The flow line of the filters is 4 ft. above the top of the sand and 5½ ft. below the reservoir flow line.

Water is carried from the main collecting drains through 10-in. cast iron pipes, which are connected in the gate house with a 20-in. stand-pipe. Just below these connections there occurs in the 20-in. stand-pipe a horizontal brass diaphragm, through which slides a brass tube 13 ins. in diameter inside. The elevation of the upper end of this tube determines the acting head upon the filters, and this head can be increased or diminished by lowering or raising the tube. The arrangement of the piping in the gate house is shown in plan and elevation by Fig. 29, in the text. A cross section of the device for regulating the head of water on the filter beds is shown by Fig. 30 and the details of the regulator at the points marked A, B and C are shown in Fig. 31.

The village draws its supply from the clear water basin (Fig. 28 in the text and Figs. 5 and 6 on the inset), a circular reservoir of 500,000 gallons capacity, the flow line of which is 9 ft. below the flow line of the filter beds and 267 ft. above the lowest portion of the village. The clear-water basin was built partly by excavation and partly by embankment, and the same method as above described for the main embankment of the reservoir was followed in building this embankment. The bottom and side slopes were covered with clay puddle, 12 ins. thick on the bottom and 18 ins. thick on the slopes. The bottom was finished with a 6-in. layer of concrete laid on the puddle. The puddle on the side slopes

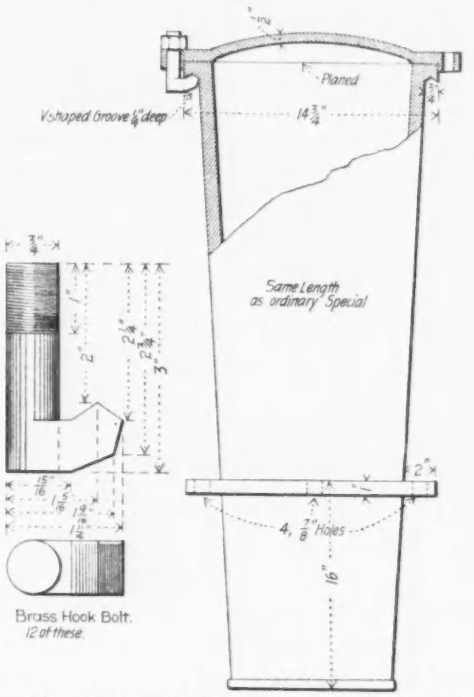


Fig 27. Eight to 12-in. Increaser and Cap, Ilion Water-Works Fountain.

was covered with a hammer-dressed slope wall 12 ins. thick, backed with 6 ins. of gravel.

The flow lines of the filter beds and clear-water basin are determined by open stand-pipes placed in the gate house, which is provided with a sub-floor of bluestone, laid in cement on concrete, for receiving the overflow, and a 24-in. tile drain for carrying it away.

It will be seen from inspection of the arrangement of pipes in the gate house, Fig. 29, that the village can be fed from the stream by way of the filter beds and clear-water basin, or from the reservoir by way of the filter beds and clear-water basin, or from the reservoir by way of the clear water basin without filtering, or directly from the reservoir or from one or both filters directly. The arrangement also permits of cleaning one filter bed without interfering with the working of the other, and of filling either bed from the bottom with filtered water from the other.

It was determined by experiment that with the sand in average condition, the filter beds would pass 67 gallons per sq. ft. in 24 hours with a head of 6 ins., or 2,418,520 gallons per acre.

The actual cost of cleaning both beds, without renewing the sand removed, was $8.25. Assuming the beds to be cleaned eight times a year by the removal each time of a paring ½ in. thick and assuming a loss of 20% in rewashing the sand removed, the cost of maintenance of these filters, including interest on the cost of the washing machine and pipe line laid for it, will probably be about 1.9 cents per sq. ft. per annum, or if they filter at the average rate of 67 gallons per sq. ft. in 24 hours the cost per million gallons will be about 78 cents. The beds were designed to filter at the maximum rate of 90 gallons per sq. ft. in 24 hours. Assuming that twelve cleanings per year would be necessary to keep them up to this rate, the cost of maintenance will probably be about 2.7 cts. per sq. ft. per annum, or 82 cts. per million gallons.

In the operation of the beds in winter it has been found that the water applied to the filters from near the bottom of the reservoir is so warm as to prevent any freezing on the side opposite the inlet pipes, and the ice formed on the other side is melted by towing it into the open water. It would seem from this that the depth of water on the beds could have been reduced to 2 ft. as a maximum and the construction cheapened by this decrease in depth.

No analyses have as yet been made to determine the actual purification effected, but the appearance of the water is materially improved. We hope this year to have made a number of chemical and biological analyses of the water before and after filtration.

The works were put in operation on Sept. 30, 1893. The filters were cleaned first on Nov. 15, 1893. They were operated efficiently from that date until April 15, 1894, by twice reversing the water from one filter through the bottom of the other and vice versa without scraping the sand. The surface of the sand, however, was twice raked over with a large rake, having teeth about 1 in. long. The rake with short teeth was used because it was not desired to mix the sediment held on the surface of the sand with the clean sand underneath, and because the reversal of the current acted very efficiently in loosening up the under sand.

In the operation of the beds it is found that the first marked decrease in their filtering capacity occurs about one month after cleaning.

The writer believes this to be due to a thin membranous film, which forms upon the surface of the sand and is made up of the matter which was held in suspension by the unfiltered water, together with a certain membranous substance which is probably the zoogloea described in the reports of the Massachusetts State Board of Health and in reports upon

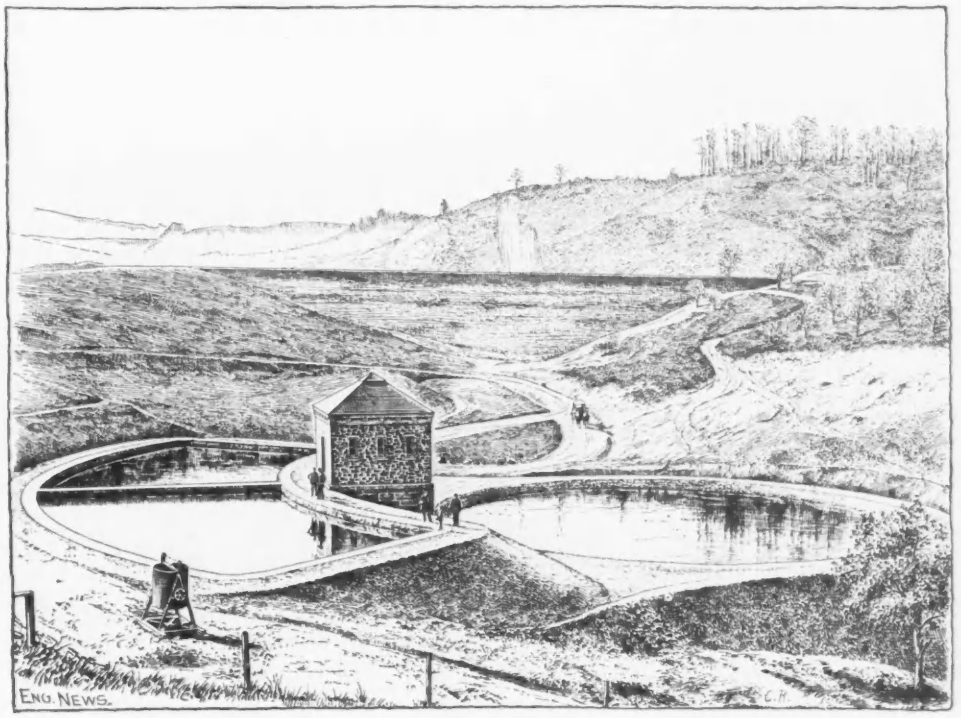


FIG 28. VIEW OF ILION FILTER BEDS, CLEAR WATER BASIN AND GATE HOUSE.

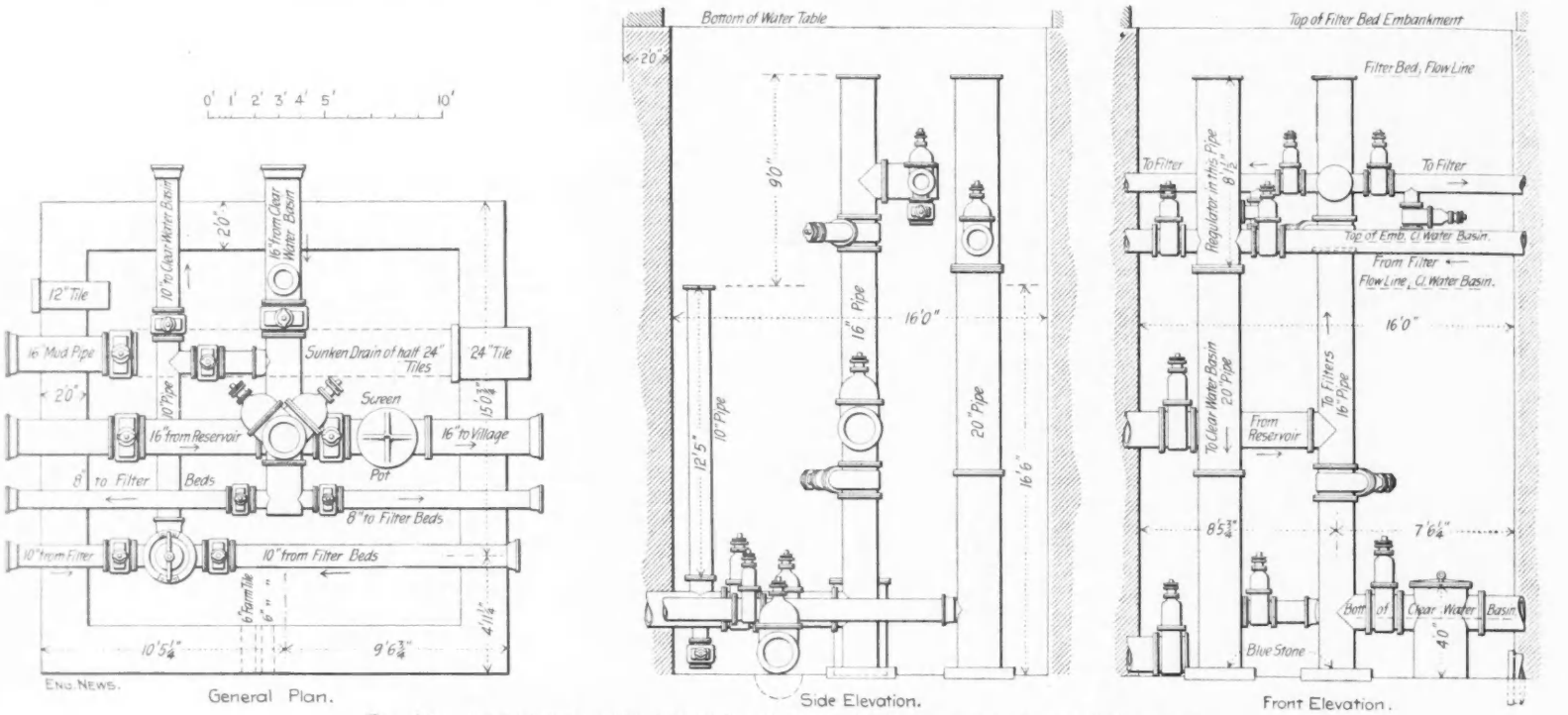


Fig. 29. ARRANGEMENT OF PIPE GATE HOUSE OF ILION FILTER BEDS.

the operation of continuous filters in Germany. The membranous character of the film is very marked, so much so that in reversing the current it becomes detached and floats to the surface of the water in flakes of a square foot or less in area.

It is further believed that the decrease in filtering capacity is due not only to the existence of this film, but also to the packing of the sand below, which increases with the head required to force water through it. On this account the reversal of the water through the filters is a valuable feature of the design, although our opinion is that it should only be used as an auxiliary to the scraping of the sand.

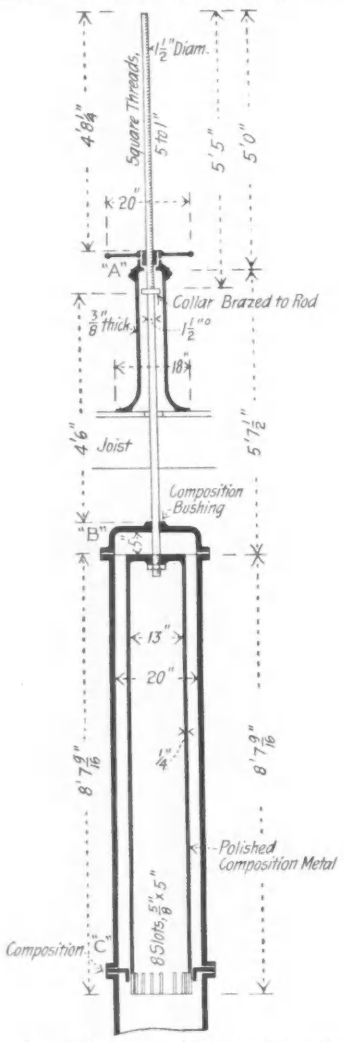


Fig. 30. Cross-Section of Device for Regulating Head on Ilion Filters.

The total cost to the village of constructing the whole system, including about 16 miles of pipe from 16 to 4 ins. in diameter, 104 hydrants and 180 valves, was in round numbers $82,000. This does not include lands and right of way, engineering and inspection or legal and incidental expenses.

The cost of those portions of the work which go to make up the filtering plant were as follows:

Filter beds proper	$7,111
Gate house and connections	4,484
Clear-water basin	3,797
Total	$15,392

The item gate house and connections includes all the flanged special castings, flanged valves, regulator, gate stems, screen pot and screens, which are situated in the gate house, besides the cost of the building. There should be deducted from the above total about $1,400, which would have necessarily been expended in the construction of a gate house with its accessories if the filtering plant had not been built. This deduction would leave in round numbers $14,000 as the cost of constructing that part of the plant made necessary in order to filter the water.

Detailed Cost of Filter Beds, Gate House and Clear Water Basin, Ilion, N. Y.

Filter beds.			
170 cu. yds. ashlar masonry	@	$10.00	$1,700
332 " " rubble "	"	5.50	1,826
240 " " concrete	"	5.00	1,200
110 " " filtering gravel	"	1.50	165
551 " " " sand	"	1.50	827
900 " " embankment	"	.32	288
32.3 M. brick, laid dry	"	8.00	258
11.8 " " " in cement	"	12.50	148
431 lin. ft. cut coping, 6 × 30 ins.	"	1.25	539
176 " " " " 4 × 12 ins.	"	.35	61
247 sq. ft. 6-in. Hudson R. bluestone flagging	"	.40	99
Total			$7,111
Gate House and Connections.			
183 cu. yds. rubble masonry	@	$6.00	$1,098
14.5 " " ashlar "	"	12.00	174
47.2 " " concrete	"	5.00	236
18 sq. ft. 6-in. plain Hudson River bluestone	"	.40	7
228 sq. ft. 3-in. Hudson River bluestone flagging	"	.35	80
8 lin. ft. 24-in.. half tile	"	3.00	24
23,525 lbs. flanged specials	"	.04	941
Six 16-in. flanged valves	"	66.00	396
Four 10-in. " "	"	30.00	120
Two 8-in. " "	"	25.00	50
Three 6-in. " "	"	15.00	45
1,188 lbs. composition metal	"	.30	356
868 " wrought iron	"	.08¼	72
1,112 " cast iron	"	.06	67
1 copper screen	"	30.00	30
30 ft. 16-in. pipe laid	"	1.90	57
76 " 10-in. " "	"	1.00	76
50 " 8-in. " "	"	.80	40
Gate house complete above bottom of water table			615
Total			$4,484
Clear-Water Basin.			
3,348 cu. yds. embankment	@	$.32	$1,071
273 " " hammer dressed slope wall	"	5.25	1,433
709 cu. yds. clay puddle	"	.85	603
67 " " concrete	"	5.00	335
142 lin. ft. 24-in. tile	"	2.50	355
Total			$3,797

It may not be improper for me to say that all of the work entering into this construction is of very substantial character and its quality is considerably above the average of similar work with which I am familiar. An efficient plant could have been built for considerably less money by substituting rubble for cut stone, ordinary for hammer-dressed slope wall and by cheapening the plant in other particulars.

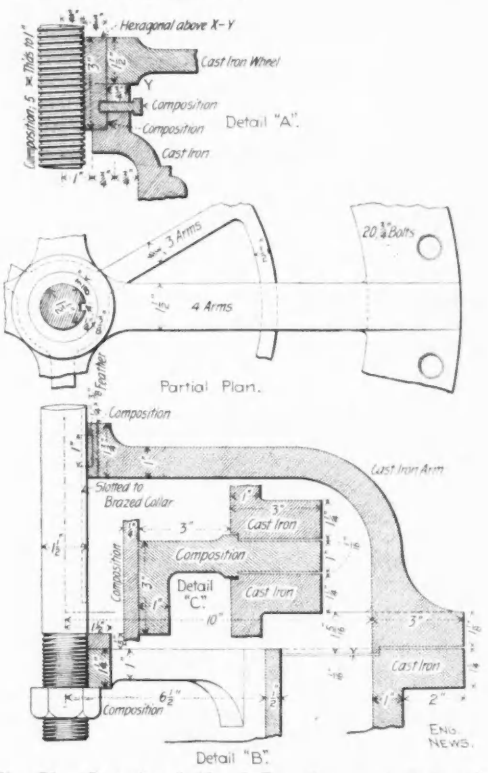


Fig. 31. Details of Head Regulator at Points in Fig. 30 Marked A, B and C.

The Aerating Fountains at Ilion and Frankfort, N. Y.

An aerating fountain similar to that at Ilion, described above (see Figs. 25, 26 and 27 in the text), is in use at Frankfort, N. Y., in connection with

works there built by the Stanwix Engineering Co., of Rome. The following information regarding the Frankfort fountain and the general discussion regarding it and the Ilion fountain was prepared for use in this connection by Mr. J. W. Kittrell, of the above company:

The plan for the Frankfort work is very similar to that for the Ilion work. Water is diverted from a stream into an 8-in. main, which conducts it to a storage reservoir two miles from and 80 ft. lower than the intake. The storage reservoir serves also as a distributing reservoir into the village piping system. There is no filtering plant. The Frankfort fountain is designed to discharge only about 400,000 gallons in 24 hours, or less than half the discharge of that at Ilion.

The reasons for adopting aeration at Frankfort are, that in the present condition of the watershed the supply is much less liable to contamination than that at Ilion and a filtering plant was not thought necessary for the present; the reservoir at Frankfort is deep and the water is to be taken from near the bottom, and it was thought that aeration during the summer months would lessen the liability of spoiling the bottom water; finally, since the additional cost of the fountain will not exceed $250, it was thought to be worth that amount of money as a purely ornamental feature.

It is not expected, nor will it be possible, to use either the Ilion or the Frankfort fountain all the year, since neither of them will discharge enough water to maintain the necessary storage, but for six or nine months of the year they will discharge all of the flow of their respective streams, and these months are the ones in which bad tastes and bad odors are likely to occur in water supplies. During the remaining months the gravity lines from the diverting dams to the reservoirs must discharge at their maximum capacities in order to maintain the storage.

In neither the Ilion nor the Frankfort system do the fountains represent any larger expenditures of money than were necessary to build the piers, lay the connecting discharge pipes and furnish the caps and nozzles; that is, no longer pipe line has been laid in either case to reach a higher elevation for the purpose of obtaining head for a fountain. The head sought and obtained has been only that necessary to furnish the required maximum discharge into the reservoirs through the open end of the gravity main, but after this has been done discharging the summer flow through a fountain follows almost as a matter of course.

In connection with the Ilion fountain, it seems to me that water thrown into the air in such a finely divided state and falling into the reservoir, the effluent pipe of which is 25 ft. below the surface, is bettered in condition, outside of any direct advantage from aeration, by its larger proportion of dissolved oxygen. Experience with deep reservoirs where water is drawn from near the bottom shows that the greater the amount of dissolved oxygen the less is the liability of the spoiling of the bottom water during its period of summer stagnation.

If it is true that such a fountain increases the amount of oxygen held in solution, and it seems reasonable to suppose that it does, then it must be a feature of some value in the usual design of storage reservoirs of small capacity where inlet towers are rarely used and water is always drawn from near the bottom. Further, if the premise as to the greater amount of dissolved oxygen is true, such a fountain is of value as an adjunct to a system of continuous filtration, since the chemical purification effected by a continuous filter depends very largely upon the amount of dissolved oxygen contained in the water.

The comparative merits of different paving materials for Chicago have been classified as follows by Mr. D. W. Mead:

	Asphalt.	Brick.	Cedar block.	Cobble-stone.	Granite block.	Mac-adam.
First cost	5	4	2	1	6	3
Cost of maintenance	4	1	5½	3	2	6
Facility of repair	6	2	5	4	3½	1
Durability under traffic	4	1	5	3	5½	6
Freedom from noise	3	4	2	6	5½	1
Freedom from dust	1	2	4	5	3	6
Freedom from decay	5	1	6	3	2	4
Freedom from absorption	1	2	6	4	3	5
Foothold for horses	6	4	5	1	2	3
Ease of traction	1	2	3	6	5	4

A NEW MECHANICAL FLUID.*

By Charles Wallace Hunt.

A hydraulic piston for adjusting journal boxes to take up the wear from use would have the desirable features of delicacy of adjustment and ample rigidity for any strain which it would be called upon to sustain. The cost of the accurate construction needed, and the probable leakage of the fluid, would usually prevent serious consideration of this method. In canvassing the various methods of adjustment which could be used in the bearings of the connecting rods of our steam engines, the advantages and faults of this method were carefully investigated. The inevitable leakage of the liquid presented an almost unsurmountable barrier to its use.

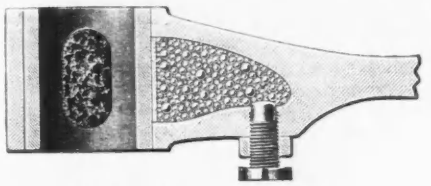
By making a wide departure from our ordinary conceptions in molecular physics, we can imagine a liquid composed of atoms as large as bicycle bearing-balls. The anticipated trouble from the leakage of the fluid would then disappear as a factor in the ordinary mechanical fitting in steam-engine work.

If the balls of this hypothetical fluid vary in size, their mutual pressures may be supposed to balance each other. If the balls were infinite in number, and the size limited, but with an infinite number of variations of diameter within the limits, the various local pressures would be balanced, and the mass would have the mobile property of a liquid.

Under compression each ball of a mass of various sizes would have the resultant of all the pressures on it at its centre, and consequently would be in a position of equilibrium; but should the inclosing envelope change in form or capacity, a change in the direction of the pressures would take place; first, in the balls nearest to the movement, then in the adjoining ones, the balls severally moving in the direction of least resistance, until the resultant of the pressures again came in the center of each ball.

If the mass of balls were all of one size they would interlock. This rigidity resembles the property of a solid.

A mass of balls of various sizes, under pressure, does act like a liquid, as we have ascertained by testing in various ways. (On the table, at the reading of the paper, was shown a connecting rod of full size fitted up to be adjusted in this manner, just as it is used in practice, and also a model with a glass front and a spring piston, which permits the individual motion of the steel balls to be seen when the adjusting screw is turned. The mass is kept mobile by putting sufficient pressure on the movable piston.)



A New Mechanical Fluid.

The accompanying cut shows a section of a solid-end connecting rod, having an annular brass bushing with an opening, in order that adjustment for wear can be made. One side of the bushing is held in place and adjusted by the pressure of a mass of hardened steel balls, varying in diameter from ⅛ to ¼ in. Between the bushing and the balls is a thin plate of hardened steel to prevent the balls from indenting the softer metal. The adjustment for wear is made by forcing the mass of balls forward with a hardened steel adjusting screw.

When the wear has become so great that the range of the adjusting screw has been exhausted, a few more balls are inserted under the point of the screw, and an adjustment of the bearing is made as before. On the crank end of the rod, the adjusting screw is on top, but on the cross-head end it is on the front side, clear of the cross-head, where the adjustment is as conveniently made as it is on the crank end.

We have been running last year 40 bearings of this type in various places, in the East and in the West, working with steam-boiler pressures of from 80 to 160 lbs., giving pressures per square inch of projected area of the pins ranging from 600 to 1,000 lbs. The pressure on the balls per square inch is about 50% greater. If we assume that the balls are about ¼-in. diameter, and that 60 balls are in contact with the bushing on each square inch, the pressure sustained by each ball would be from 15 to 25 lbs. Assuming that the elastic limit of the steel in the connecting rod shown is 30,500 lbs. per sq. in., and that the hardened steel balls have a pressure of 25 lbs. on each one, we would expect that each ball would imbed itself in the steel envelope until the area sustaining the pressure was strained to the elastic limit. This area would be 1-1270-sq. in. for each ball, which is almost exactly equal to the area of a circle 1-100-in. in diameter.

At first the bearings require frequent adjustment, but the balls soon get in a fixed position, and then they need adjustment for the wear of the bushing only. The adjustment of these bearings is apparently as delicate and positive as though a liquid was used. In cases where the adjusting screw was purposely made to turn freely, the adjustment could easily be made by the thumb and fingers, and if care was not used, too great a pressure on the pin would result.

The connecting rod shown is for a 10-in. diameter cylinder steam engine and is a steel casting, made by I. G. Johnson & Co., fitted with an adjusting screw having 14 threads per in., and a pressure area of balls on the bushing 18 times the area of the screw. If the screw is turned with a force of 25 lbs. on an 8-in. wrench, the friction of the screw absorbing 25% of the force, the pressure on the bushing would be over 50 tons. While this pressure might be used in other applications of this novel fluid that have been proposed, it was clearly out of place in connecting-rod bearings, and we now make the head of the adjusting screw of such a form that an ordinary wrench cannot be used, and the adjustment is made only by a spanner which will, by its peculiarity, remind the engineer that care is necessary in the adjustment.

* Condensed from a paper read at the Montreal Meeting of the American Society of Mechanical Engineers.

THE DIAMOND SHOALS LIGHTHOUSE.

Investigations are being made again as to the practicability of establishing a lighthouse on the Diamond Shoals, off Cape Hatteras, where a foundation caisson for a lighthouse was lost in July, 1892. For making borings a special apparatus was constructed by Mr. Julius E. Rettig, Superintendent of Construction, under the direction of the Lighthouse Board. As described by the Philadelphia "Press," this apparatus had the form of a skeleton prism, 20 ft. square and 32 ft. high, built up of hollow wrought iron columns, hollow wrought iron struts and tie rods and cast iron sockets at the corners, carrying on the upper end a platform.

The structure weighed about 32 tons and was floated by two pontoons, each 24 × 9 × 6 ft., which were clamped in such ways to the structure that they could be liberated as soon as the skeleton was sunk upon the shoal. Through each of the four hollow vertical columns of the structure passed a wrought iron pile 6 ins. diameter and 50 ft. long, having on its lower end a cast iron disk 3 ft. diameter, and on its upper end a screw thread and cast iron flange nut. The pile was held by a clamp neatly fitted into a recess 15 ft. from the upper end. The disk at the lower end was cored in such a manner that a water current could be passed through it, and that the water could escape through two 1½-in. openings through the face of the lower disk. Wrought iron pipes and lines of rubber hose were used to conduct water under pressure from the tugboat which was in attendance to the four disks.

The apparatus was erected first upon a barge, and then lifted off by the two large shears at Newport News and transferred to the water. When rigged for transportation to the site it drew 21 ft. of water. In this condition the apparatus was towed out to the shoal on May 25, but as the weather was unfavorable a wait was made until 11:30 a. m., May 27, when at high tide and under favorable conditions the structure was successfully sunk at a point previously marked by the Coast and Geodetic Survey. Within 15 minutes afterward the pontoons were disconnected and drifted off in the strong current of two or three miles an hour which prevails at the shoals, and when the vessel had been securely moored alongside the structure it required but three-quarters of an hour to sink the last iron disks of the piles to a depth of 13 ft. below the bottom of the ocean. By bolting the flange nuts of the piles to the upper sockets of the structure the apparatus was completely secured to the bottom.

In order to determine the character of the soil a 2-in. pipe was sunk from the platform of the framework into the bottom of the ocean to a depth of 105 ft., in the following manner: First, a 5-in. pipe 60 ft. in length was sunk 40 ft. into the bottom. Then a 3½-in. pipe was built up inside the 5-in. pipe already sunk, and when the 3½-in. pipe had reached a total length of 98 ft. it was sunk to a depth of about 78 ft. below the bottom of the ocean; the sand thereby washed to the surface between the larger and the smaller pipe was caught on the surface of the water in a canvas bag. After

the second pipe was sunk, the smaller 2-in. pipe, having a total length of nearly 147 ft., was sunk through the 3½-in. pipe to a depth of 105 ft., as above stated. The planting of the framework at the site and making the borings occupied in all only nine and one-half hours. The material brought up from a depth of 105 ft. consisted of fine black alluvial sand mixed with small shells and mud, a material most unfavorable for carrying heavy loads, and easily scoured by the strong current existing on the shoals.

SCALES OF TOPOGRAPHICAL SURVEYS OF VARIOUS COUNTRIES.

In a report on the facts and possibilities of topographic work, to the U. S. Coast & Geodetic Survey, Assistant August F. Rogers gives the following table of scales of topographical surveys of foreign governments and the United States:

Great Britain	1 — 500 for cities; 1 — 2,500 for country in general.
France (formerly)	1 — 2,000, 1 — 5,000 for fortified places and vicinity; 1 — 4,000 for general country.
France (now)	1 — 10,000 for country in general; 1 — 20,000 for mountainous districts.
Algeria	1 — 40,000 in northern part, 1 — 100,000 in southern part.
Belgium	1 — 20,000
Denmark	1 — 20,000
Holland (old)	1 — 25,000
Holland (new)	1 — 5,000 (1874)
Sweden & Norway	1 — 20,000 for settled districts; 1 — 50,000, and 1 — 100,000 for northern part and high mountains.
Germany	1 — 25,000 in general; 1 — 10,000 in special localities; 1 — 500, 1 — 1,000, 1 — 2,500 for engineering purposes; 1 — 125, 1 — 250, 1 — 500 for cities and vicinity.
Austria	1 — 12,500 for special locations; 1 — 25,000 in general.
Switzerland	1 — 25,000 general; 1 — 50,000 in mountainous districts.
Italy	1 — 25,000 in general; 1 — 50,000 in mountains; 1 — 10,000 for certain seaports and vicinity.
Spain	1 — 25,000.
Portugal	1 — 50,000 and 1 — 100,000.
Russia	1 — 21,000 in settled districts; 1 — 42,000 for northern provinces; 1 — 84,000 for the great steppes.
Asiatic Russia	1 — 17,000 to 1 — 84,000.
Roumania	1 — 50,000 and 1 — 100,000.

United States Government Surveys.

Lake Survey by Engr. Corps, U. S. A.	1 — 10,000
Coast and Geodetic Survey	1 — 10,000
" " "	1 — 2,000
" " "	1 — 40,000
Coast and Geodetic Survey, Special	1 — 600
" " " "	1 — 1,200
" " " "	1 — 4,800 etc
Geological Survey	1 — 31,250
" "	1 — 45,000
" "	1 — 62,500
" "	1 — 125,000

PERSONALS.

Mr. Harley, City Engineer of Jacksonville, Fla., has resigned.

Mr. W. B. Russell, an engineer in the employ of the Wisconsin Central Ry., was killed in a train accident at Marshfield, Wis., on that road, May 30.

Mr. E. C. Reynolds, C. E., formerly associated with N. F. Barrett, landscape engineer, has been appointed engineer of the Niagara Power & Development Co., Lewiston, N. Y.

Mr. Stewart Johnson, Chief Engineer of the Grand Rapids & Indiana R. R., has resigned his position, to accept that of General Manager of the Consolidated Street Ry., Grand Rapids, Mich.

Mr. H. R. Nickerson, General Superintendent of the Atchison, Topeka & Santa Fe Ry., has resigned his position, to accept that of Assistant General Manager of the Mexican Central Ry., with headquarters in the city of Mexico.

Mr. J. Lowrie Bell, Second Assistant Postmaster-General, has tendered his resignation, to take effect June 30, in order to accept the office of General Traffic Manager of the Central Railway of New Jersey, with headquarters in New York.

Mr. T. H. Fennell, formerly General Superintendent of the Northern Division of the Lehigh Valley R. R., has been appointed Superintendent of the Western Division of New York & New England R. R., with headquarters at East Hartford, Conn.

Mr. W. C. Cushing, Engineer of Maintenance of Way of the Indianapolis Division of the Pennsylvania Lines, has been transferred to the Pittsburg Division, and Mr. L. Byers, of the Cincinnati & Muskingum Valley Division, will succeed him on the Indianapolis Division.

Mr. H. M. Gates, of Columbus, O., Chief Engineer of the Scioto River Commission, has completed the work of establishing the boundary of the Scioto River through the city limits of Columbus. The commission has now finished its work and will submit its final report.

Mr. Hiram Nevons, for the past 17 years Superintendent of Water-Works at Cambridge, Mass., died at his home, in Cambridgeport, on May 27, after a long illness. He was born in New Gloucester, Me., 58 years ago. In early life he was a ship carpenter. He was appointed Superintendent of the Water Department early in 1877.

Mr. Horace C. Alexander, of the firm of Alexander, Hill & Enricht, of Chicago, has been appointed Superintendent of Lincoln Park, Chicago, by Governor Altgeld, of Illinois. Mr. Alexander graduated from the University of Michigan in 1882 and since that time has been steadily engaged in railway and municipal engineering.

Mr. H. U. Mudge, General Superintendent of the Western Division of the Atchison, Topeka & Santa Fe Ry., has been appointed General Superintendent of the Eastern Division, with office at Topeka, Kan., and Mr. Charles Dyer, Division Superintendent at Las Vegas, N. M., has been appointed General Superintendent of the Western Division, with headquarters at Colorado Springs, Colo.

Mr. Charles Hansel, C. E., at present Western Manager of the National Switch & Signal Co., of Easton, Pa., has been elected vice-president and general manager of that company, with headquarters at 32 Liberty St., New York, after June 1. The western office of the company, at 1236-7-8, Monadnock Block, Chicago, will be placed in charge of Mr. H. M. Sperry, who for some years has been connected with the Johnson Signal Co., as general representative. Mr. George H. Hansel has been elected secretary and treasurer of the National Switch & Signal Co., with office at the works, Easton, Pa.

Mr. Gilbert Murdoch, Chief Engineer of the Water Department at St. John, N. B., died May 28. He was born in Paisley, Scotland, in 1820 and went to St. John when only 22 years of age. He was the Chief Engineer of the Water Department since 1855. At that time the city got its water supply from Lily lake. The water was brought in to the Marsh bridge, where there was a powerful pumping engine which forced it up to the higher levels. The work of bringing the water in from Loch Lomond was accomplished under his direction, and he was strongly in favor of improving the supply by the extension of the mains to Lake Latimer. The sewerage system of the city was built under Mr. Murdoch's management.

Mr. W. C. Van Horne, President of the Canadian Pacific Ry., has accepted the title of knighthood, somewhat to the surprise of those who know his independence of character. He is an American, having been born in Illinois in 1843, commencing his experience in railway work in 1856, as a telegraph operator on the Illinois Central R. R., from which position he rose by numerous steps until in 1880 he became General Superintendent of the Chicago, Milwaukee & St. Paul Ry. In 1882 he was appointed General Manager of the Canadian Pacific Ry., in 1884 he became Vice-President, and in 1888 President of the company. To his enterprise and energy is due in a large measure the successful management of that road.

Mr. John McCaffery, who died at Chicago June 1 of typhoid fever, was born near Belfast, Ireland, June 26, 1808. He came to America when quite a lad with his parents and settled in North Carolina, where he grew up and became a contractor. Subsequently he removed to Virginia and was one of the contractors on the James River & Kanawha Canal. A few years later he moved to New York and was one of the contractors on the Erie Canal. In 1840 he went to Chicago and was one of the contractors on the Illinois and Michigan Canal. He always afterward resided in Chicago and followed the business of a contractor until seven years ago, at which time he abandoned active pursuits. He was a director of the Illinois Trust and Savings Bank for 23 years, and a director for a shorter period of the Grand Trunk Ry. Co.

NEW PUBLICATIONS.

JUNE MAGAZINES.—In "Scribner's," Archibald Forbes writes on "The Future of the Wounded in War," and presents a spectacle which makes one recoil in horror from the probable consequences when the modern military machinery with which the great nations of the world are now equipped is brought into actual service in the work for which it is designed—killing men. Mr. Forbes thinks that in the next great war, the exigencies of the campaign, and the enormous destruction wrought in battle, will make the care of the wounded by the victor practically impossible. The Red Cross Society and similar humanitarian organizations will have the whole burden of rescuing the wounded, and these cannot do their work till the battle is over. The moral which the famous old war correspondent draws is that war's barbarities are becoming too much of a contrast to our Christian civilization to be permitted to continue.

In the "Forum" Prof. E. L. R. Gould, of Johns Hopkins University, tells how Baltimore banished tramps and helped the unemployed during last winter's trying times. The plan adopted was the establishment of a "wayfarer's lodge," where destitute wanderers paid for food and shelter by sawing and splitting wood. For more permanent employment, four stone-breaking yards were started, and operated by task work, and about 7,000 tons of stone were broken during the winter.

TREATISE ON THE SOUTH AMERICAN RAILWAYS AND THE GREAT INTERNATIONAL LINES. Published Under the Auspices of the University of Fomento of the Oriental Republic of Uruguay, and Sent to the World's Exhibition at Chicago. Montevideo, Office of International Publications. New York, Bothfeld & Weygandt. 8vo; pp. 601; illustrated.

This is a very important and interesting review of South American railways, compiled and issued under the direction of the Government of Uruguay. The views expressed as to the prospects of the projected intercontinental railway are very much too sanguine, it being stated that its success is "fully guaranteed" by the initiative taken by the United States, implying that the construction of the work is being promoted by this country. Besides the statistical and tabular matter, there is a large amount of interesting and valuable information relative to the technical features of South American railways, grades, curves, bridges, tunnels, roadbed, cross-sections, rails, etc., and the official requirements of the public works, departments. These requirements appear to be based somewhat upon the plan of those of the English Board of Trade. Uruguay railways are required to have rails not less than 60 lbs. per yd. on wooden ties, with balalst extending 3.28 ft. beyond the rails. The cross-sections show the ties covered with ballast. Railway companies are required to submit plans of their line, structures, stations, etc. In regard to the railways in the Argentine Republic the difficulties arising from the comparison of gages is pointed out. In one case a continuous line from Buenos Ayres to the Paraguay frontier, built in three sections by different companies, the first has 1.290 miles of 5 ft. 6 ins. gage, then 190 miles of meter gage, and the third section will be of 5 ft. 6 ins. gage. In most of the South American countries there is an absurd multiplication of gages which is certainly not creditable to the engineers, for one of the main objects seems to be to get a different gage for every new line so that it may keep itself aloof from its neighbors. In referring to the light construction of some of the railways, the principle for railway construction for the development of new countries is rightly said to be to "lay down the greatest number of kilometers with the smallest capital possible," which principle has apparently been followed more by the English engineers who have largely built the railways of South America, than by other English engineers who have built the railways of India and the other British colonies. Brazil is shown to be one of the most backward countries in railway development. In most of the countries there are state or state-assisted railways. The following table is a summary of the mileage and cost, etc., of railways in South America:

	Year.	Miles open.	Principal gage.	Average cost pr. mile.
Argentine Republic	1892	8,055	5 ft. 6 ins.	$49,400
Bolivia	"	572	5 " 9 "	...
Brazil	1891	6,373	3 " 3⅜ "	47,945
Chile	"	1,750	3 " 6 "	74,213
Paraguay	1892	156	4 " 8½ "	48,387
Peru	"	949	4 " 8½ "	161,200
Uruguay	"	993	4 " 8½ "	49,353

ADMINISTRATION REPORT ON THE RAILWAYS IN INDIA FOR 1892-93. By Lieut.-Col. R. A. Sargeaunt, R. E., Director-General of Railways. Calcutta. 4to; pp. 315; map.

These administration reports contain a vast amount of valuable information, but, as in most publications of this kind, they are not digested, summarized and arranged as fully as they should be, and statistics for each line are confused and rendered much less useful by being given for each half year, an unnecessary arrangement, which, like some other awkward arrangements, is apparently a relic of old customs. The fluctuating value of the rupee and the curious way of pointing off the totals by lakhs of rupees make the financial details awkward to deal with, and necessitate considerable calculation. We have pointed out several times that the railway administration of India does not appear to understand the principles of developing the resources of a country by railways, or of the construction of and development of railways, i. e., to build the greatest length of line with the least capital, and many persons interested in the development of that great country are working and fighting for a recognition of the need for more railways, and economical railways. At the end of 1892 there were 17,640 miles of railway, 10,235 miles being on the Indian standard gage of 5 ft. 6 ins., and 7,484 miles on the meter and narrower gages. Between April 1 and Dec. 15, 1894, only 395½ miles of new railway were opened to traffic, the longest piece

of which was 163 miles. Records are given of the brakes (vacuum and Westinghouse) and car lighting appliances fitted during the year, and of the varieties of fuel and oil used by each road. There are also detailed tabular statements of capital cost per mile and other statistics, which, as above noted, are not arranged for the railway system as a whole. Tables are given of the cost and dimensions, etc., of the important bridges and tunnels, and of the number of cars adapted for military purposes, i. e., fitted as ambulances or for carrying horses and guns. A summary of operating expenses compared with gross earnings is given as follows for the year 1892:

Maintenance	12.00 per cent
Locomotives	15.91 " "
Rolling stock	4.08 " "
Traffic	7.62 " "
General	5.03 " "
Miscellaneous	1.48 " "
Total	46.38 " "

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION, showing the Operations, Expenditures and Condition of the Institution to July, 1892. Pub. Doc.; 8vo; pp. 810.

This report was not presented to Congress until February, 1893, and apparently was not ready for distribution until more than a year later. Only one-tenth of the thick volume is occupied by the report proper. The rest is occupied by a "General Appendix," which may be briefly described as a reprint, as some 30 or more papers and addresses deemed of permanent scientific value but not otherwise preserved in book form. From 1880 to 1888, the plan was tried of presenting each year a summary of the scientific progress of the year in a series of specially prepared articles, but this proved unsatisfactory, and since 1889 the present plan has been followed. The most important single article of this year, perhaps, is an abridged translation of L. P. Mouillard's "L'Empire de l'Air," originally published in 1881 in a volume of 284 pages, but not heretofore accessible in English, we believe. It is here presented in 66 pages, of perhaps twice the size of the original work.

This translation alone, if the translation be in fact the only one in English, makes the volume an important one, since M. Mouillard's treatise is one of great merit and importance, one quite unique of its class, and embodying essential information not elsewhere accessible for studies of the problem of flight. The same is true in less degree of various other of the reprinted articles, many of which are readable and some of which seem important, while a few of the most careful articles in the volume, like those on the Progress of Anthology and of Astronomy, are specially prepared for it. As a whole it certainly seems as if most of the contents of this "report" deserved preservation in book form, which many of them might otherwise not have. As many of the articles have also been published in "Nature" or other periodicals which are generally preserved and readily accessible, however, one cannot but feel that the task of editing such a publication as this, so that it may really tend to the advancement of knowledge as much as possible, is a delicate one, and not likely to be always well discharged.

DIRECTORY TO THE IRON AND STEEL WORKS OF THE UNITED STATES: With a Complete List of the Iron and Steel Works of Canada and Mexico. Twelfth edition; corrected to March 1, 1894. Compiled by the American Iron and Steel Association, Philadelphia. 8vo; pp. 292.

This publication includes a full list of the blast furnaces, rolling mills, steel works, tinplate works, forges and bloomeries; rod, wire and nail works, car axle and wheel works, car and locomotive works, pipe works, shipbuilding and bridge building works, with particulars in each case. It is stated in the preface that while 1892 was a year of very general activity in all branches of the iron and steel industries, 1893 was a year of very great depression, with many failures. Few new works were built or undertaken, and some suspended work. In another column we give a summary showing the general comparison between 1892 and 1893..

NEVADA AND HER RESOURCES: A Brief Sketch of the Advantages and Possibilities of the State and the Opportunities and Inducements Offered to Capitalists and Homeseekers. Compiled Under the direction of the State Bureau of Immigration. By L. H. Taylor and assistants. Carson City, Nev.; State Printing Office, J. E. Eckley, Superintendent. 8vo; paper; unpaged; numerous illustrations, and two folding maps.

Quite an idea of the resources of Nevada can be obtained from this volume. The illustrations are all half-tone reproductions from photographs, mostly of natural scenery. Copies of the book can probably be obtained by addressing the secretary of state or the bureau of immigration, at Reno, Nev.

HOW TO BECOME A SUCCESSFUL ELECTRICIAN. By T. O'Connor Sloane. New York: Norman W. Henley & Co. Cloth; 12mo; pp. 189; illustrated; $1.

The author in the preface lays down the principle that success depends upon the man himself and not upon books and study merely, and throughout the book he emphasizes the necessity of thoroughness if the student wishes to obtain success. The book is written clearly and simply, with instructions to beginners, hints to inventors and notes for officials. The greater part of it applies as much to those in other lines of business as to electricians, and we are inclined to recommend it to every one who is making a beginning in the practical part of life. There is a fair index.

PRIMER OF NAVIGATION. By A. T. Flagg. New York and London: Macmillan & Co. Cloth; 16mo; pp. 104; illustrated; 35 cts.

This little book describes the use of the compass, log, lead, charts, etc., and contains the definitions of courses and circles, with notes on traverse and plane sailing, coasting and ocean voyages, etc.

TRADE PUBLICATIONS.

HOISTING AND CONTRACTORS' PLANT.—J. S. Mundy, Newark, N. J. Oblong; 4to; pp. 72; illustrated.

This is a very complete catalogue and price list of hoisting engines of various types (including four and eight-spool engines for bridge erection), clamshell dredging machines, boom derricks, boilers, pulleys, etc. Among minor specialties are the double-sheave headblock for pile drivers, and the Jerrold boiler tube setting. The hoisting engines are fitted with the Mundy patent friction drum.

SOCIETY PROCEEDINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—The following papers are to be presented at the annual convention at Niagara Falls: "Wire Rope Tramways," A. C. Savage; "Hoisting Apparatus of the Canal Head Gates at Sewall's Falls, N. H.," J. R. Freeman; "Marking Street Lines," C. M. Broomall; "Brafford's Ridge Tunnel," C. W. Stanford; "Tequixquiac Tunnel, Valley of Mexico," A. J. Campbell and F. W. Abbot; "Quality of Water Supply," J. W. Hill; "Sand Rock Sewers in St. Paul," Geo. L. Wilson; "The Cippoletti Trapezoidal Weir," A. D. Flynn and C. W. D. Dyer; "Submarine Removal of Rock, to a Depth of 35 Ft. Below Mean Low Water," J. A. Bensel. Additional papers promised are as follows: "Friction Rollers," C. L. Crandall and A. Marston; "Railway Signaling," J. P. O'Donnell; "Improvement of Gray's Harbor," B. W. DeCourcy; "Halsted Street Lift Bridge, Chicago," J. A. L. Waddell; "Determining the Load Line on a Telephone Exchange," A. V. Abbott; "Testing Building Stones," F. Lynwood Garrison; "The Sewerage System of Meriden, Conn.," C. Ph. Bassett; "The Power Plant of the Cliff Paper Co., Niagara Falls," W. C. Johnson; "Remuneration of Engineers," T. C. Clarke; "Chatauqua Sewage Disposal," W. B. Landreth; "Field Notes of Railway Surveys," Arthur Pew; "Philadelphia Harbor Improvement," L. M. Haupt; "Operation of Elevated Roads by Electricity," W. A. Knight.

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting on May 19, Mr. L. Y. Schermerhorn read a paper on "The Improvement of the Delaware River at Philadelphia." There are two tidal crests and troughs entering the river each day, the exact interval between high and low water at the mouth of the river being 6 h. 12 m. After the tidal wave has entered the river, however, the crest and trough cease to travel at the same rate, the former reaching Philadelphia in about 5 h. 32 m., after entering the river's mouth, while the trough or low water lags behind, requiring 6 h. 52 m. for its passage. The velocity of the high water is about 18 miles per hour, and of the low water, about 15½ miles per hour, in passing from the Breakwater to Philadelphia. The reason for this difference in velocity is due to the fact that the crest of the wave is running in water about 5 ft. deeper than is its trough. We find that the passage of the tidal wave and its trough up the river occupy such an interval of time as to make it high water at Philadelphia when it is low water at the Capes, and vice versa. We can therefore consider the water-surface to be an approximate plane, tipped first one way and then the other.

The area of the tidal basin above Philadelphia is about 15 sq. miles, and gagings made a few years ago indicate that about 2,000,000,000 cu. ft. of water pass through the harbor of Philadelphia with each ebb tide, a volume which equals about 64,000,000 tons, so that there is nearly 130,000,000 tons in flood and ebb currents passing through the harbor twice in every 24 hours.

In the present conditions of the harbor there is a mean low-water cross-section of about 55,000 sq. ft., extending in a bifurcated channel around Petty Island and at Smith and Windmill Islands. A comparison of surface would seem to indicate that the general cross-section of the river at Philadelphia has been quite constant during the successive encroachments upon its width, and that such reductions in width have been practically compensated by an increase in mean depth.

The improvement of the Delaware River at Philadelphia, involves an entire readjustment of the river from Fisher's Point to Kaighn's Point, a distance of about six miles, and requires the excavation of about 22,000,000 cu. yds. of material, at an estimated cost to the United States of $3,500,000, with a probably greater expense to the city and its commercial interests, through the wharf extension and widening Delaware Ave.

Work under this project was commenced three years ago, but after two years' operation, in which the contractor removed about 800,000 cu. yds. of material, the contract was annulled. Last June the work was renewed under a new contract, and since that date about 4,500,000 cu. yds. of material have been removed, at an average rate of over 400,000 cu. yds. per month, the maximum monthly excavation being 540,000 cu. yds., in January last. At the end of the first year, under the present contract, 5,000,000 cu. yds. will have been excavated, which is about 2,000,000 beyond the amount required by the contract.

During a part of the year 14 dredges with 90 scows were engaged upon the work of excavation, with two hydraulic dredges for placing material ashore on League Island, making altogether the largest dredging plant which has ever been assembled upon any work in the United States.

Under the project now in progress the port of Philadelphia will be given an opportunity to develop along its city frontage six miles of wharves, with a length suited to the demands of modern commerce, and with a channel depth in front of them of 26 ft. at low water and 32 ft. at high water.

Discussion.

Mr. John Birkinbine.—With the present width of channel, after heavy rains Delaware Ave. is often flooded, and I would like to know what effect the narrower channel would be likely to have, especially at times when freshets may occur in the river.

Mr. Schermerhorn.—The flooding that you refer to on Delaware Ave. is generally due either to ice gorges or to backing up of the water under a heavy wind, and freshets in the upper river have very little effect on the water surface of Philadelphia. The present mean velocity of the river is about 2 ft. per second, and we expect that after the improvements are completed, it will be nearly 3 ft. per second. Regarding the scouring of the bottom, it is not expected that the increased velocity will have any material effect upon it. L. F. Rondinella, Secy.

COMING TECHNICAL MEETINGS.

MONTANA SOCIETY OF CIVIL ENGINEERS.
June 9. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
June 11. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
June 11. Secy., M. F. Schinke, City Hall, Milwaukee.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
June 12. Secy., F. C. Osborn, Case Library Building.
NORTHWEST RAILWAY CLUB.
June 12. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
June 12. Secy., D. W. McMorris, Burke Blk., Seattle, Wash.
DENVER SOCIETY OF CIVIL ENGINEERS.
June 12. Secy., F. E. King, Jacobson Block.
MASTER CAR BUILDERS' ASSOCIATION.
June 12, 16. Saratoga, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
June 13. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
June 13. Secy., F. M. Curtis, P. O. Box 1576, Boston.
ENGINEERING ASSOCIATION OF THE SOUTH.
June 14. Secy., Hunter McDonald, Nashville, Tenn.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
June 14. Secy., G. W. Shaw, Norton Building.
NEW ENGLAND WATER-WORKS ASSOCIATION.
June 14, 16. Annual convention at Boston. Secy., R. C. P. Coggeshall, New Bedford, Mass.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
June 15. Secy., D. W. Meeker, St. Paul.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS
June 15. 201 Washington Building.
ENGINEERS' CLUB OF PHILADELPHIA.
June 16. Secy., L. F. Rondinella, 1122 Girard St.
SWEDISH ENGINEERS' CLUB.
June 16. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 106 Randolph St., Chicago. Secy., C. T. Anderson.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
June 17. Secy., C. H. McLeod, Montreal, P. Q.
ENGINEERS' CLUB OF MINNEAPOLIS.
June 18. Secy., E. Nexsen, 504 Kasota Block.
MASTER MECHANICS' ASSOCIATION.
June 19, 23. Saratoga, N. Y. Secy., Angus Sinclair, Temple Court, New York.
COLUMBIAN ENGINEERING SOCIETY.
June 19. Secy., F. W. Hart, Washington, D. C.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
June 20. Annual meeting at Niagara Falls. Secy., F. Collingwood, 127 E. 23d St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
June 20. Secy., Wm. H. Bryan, Turner Bldg.
BOSTON SOCIETY OF CIVIL ENGINEERS.
June 20. Secy., S. E. Tinkham, 36 Bromfield St.
ENGINEERS' CLUB OF CINCINNATI.
June 21. Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
June 21. Secy., Howard Berge, 100 Washington St.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
June 21. Secy., Daniel Carhart, Carnegie Lib. Bldg., Allegheny.
WESTERN SOCIETY OF ENGINEERS.
July 4. Secy., Thos. Appleton, Lakeside Bldg., Chicago.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
July 6. Secy., E. K. Smoot, 803 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
July 6. Secy., O. Von Geldern, 719 Market St., San Francisco.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
July 14. Alleghany Springs, Va. Secy., J. A. Pilcher, Roanoke, Va.

ENGINEERING NEWS

AND

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A hint of the direction in which manufacturing industries in heavy iron and steel are extending in this country is furnished by a note which this week comes to our desk of the shipment of two large Corliss engines from an establishment in West Duluth, Wis. (the Marinette Iron Works), to New Orleans, La. That an establishment so far distant should be able to compete with the shops of the Eastern and Central States in taking such a contract is very remarkable. It is interesting to recall that within the memory of men still in business life New England furnished heavy machinery for the rest of the country.

The valuable work which may be done in engineering literature by selecting a single subject or phase of a subject and treating it in an exhaustive manner is well illustrated by the series of articles concluded in this issue on "Stand-Pipe Accidents and Failures." The author, Mr. Wm. D. Pence, Assistant Professor of Engineering in the University of Illinois, has collected all possible information bearing upon his subject. Resisting the temptation to publish a general treatise on stand-pipe construction, he has thus made immediately available an historical record of stand-pipe accidents and failures in this country, supplementing it by a discussion of the failures as a whole and of stand-pipe failures in general. Every busy engineer who has attempted to secure exhaustive information on almost any engineering subject knows that most of the books from which he expects help contain only sketchy presentations of the subject he is investigating, owing to the fact that in trying to give a little of everything the authors lack space, or knowledge, to give everything of something. Turning to the technical papers, as must almost invariably be done to secure the nearest approach to the whole and the latest of the available information sought, it is found that the information here is widely scattered, as it must be in this age of progress. It is mainly to exhaustive monographs like this one by Professor Pence or special treatises of a more extended character, when the subject warrants it, that one must look for anything like an adequate presentation of a special branch or phase of engineering, or indeed of any other science.

We give space elsewhere in this issue to an interesting description of a "New Mechanical Fluid," or more accurately a method of obtaining hydrostatic pressure by substituting for the liquid commonly used a collection of hardened steel balls. That a solid mass consisting of finely divided particles, which move upon each other with little friction, approximates a liquid in its physical characteristics is a fact which has long been known to engineers. Any one who has had experience with quicksand can testify that the facility of movement which such a mass posseses sometimes surprises even the experienced. There are not wanting examples, either, that the fluidity of such a mass depends directly upon the amount of friction between its particles. Thus a sand which would form a stable foundation when dry may become a most yielding and treacherous mass when its particles are lubricated by the saturation of the mass with moisture.

But while these principles have long been known, it remained for Mr. C. W. Hunt, whose ingenuity in the invention of new departures in mechanical design is well known, to apply these principles in the design of a "mechanical fluid" to be substituted for water or oil in certain places where the gradual leakage of a liquid makes it inapplicable. Elsewhere in this issue we show a connecting-rod bushing arranged for adjustment by this "mechanical fluid," which consists of hardened steel balls of various sizes, well lubricated. Such balls are now made in enormous quantities for use in ball bearings and are purchasable at a moderate price. As there is no leakage, and apparently no wear (when used merely for adjusting bearings), the cost of the bearing should be very moderate. It would be interesting to know what are the limitations to the use of this new "fluid." Apparently it should be applicable to a large variety of uses where the leakage of an actual liquid has hitherto prevented the use of the hydrostatic principle. Of course the "mechanical fluid" differs from the liquid in having a friction of rest as well as a friction of motion, and in having particles which will be deformed or injured so as to increase greatly the friction, if they are subjected to pressure beyond their elastic limit. These limitations will probably prevent the use of the "fluid" where a considerable motion is required, as in hydraulic jacks; but it is to be hoped that experiments may be made to determine the exact amount of the internal friction and the safe limits of pressure which may be used. With this knowledge the extent to which Mr. Hunt's ingenious invention is applicable can be laid down with fair accuracy.

THE ELECTROLYSIS OF PIPES.

The electrolysis of water, gas and other metal pipes laid in city streets through which pass trolley systems of electric cars is receiving an increasing amount of attention all over the country. Mr. J. H. Van Cleef, Mayor of New Brunswick, N. J., recently vetoed an ordinance granting a franchise to a street railway company, one of the chief grounds for his veto being that the ordinance contained no safeguard against electrolysis. The water and gas companies of San Francisco, Cal., are much exercised over the dangers from electrolysis in that city, the gas company fearing explosions and fires. The water commissioners of Newburg, N. Y., have been consulting recently, through their engineers, Messrs. John D. Van Buren and Everett Jamison, with Mr. I. H. Farnham, M. Inst. Elec. E., regarding the protection of their water mains against current from a trolley railway now under construction. In numerous other cities investigations are being made and papers on the subject are appearing at frequent intervals before engineering societies and in technical journals (see Eng. News, Sept. 22 and Dec. 29, 1892; Sept. 14 and 28, 1893; Jan. 11, Feb. 1, March 1, 15, 22 and 29, April 26, May 3 and 24, 1894). A paper entitled "The Electrolysis of Water-Pipe" is to be read on June 14 by Mr. C. A. Stone before the New England Water-Works Association and one on the same subject was read last fall before the American Water-Works Association by Mr. Peter Milne, and only a few days ago the Pacific Coast Gas Association appointed a committee to investigate the subject.

The matter is one to which the water-works and gas associations of the country, as well as the various electrical societies, should give immediate and earnest attention, as they no doubt will. There is a growing disposition to hold electric railway companies responsible for damages caused by ground currents and a crop of lawsuits over the points involved is likely to develop at an early day. In one sense the trouble may be said to have only just begun, owing to the recent construction of many trolley lines and the lack of attention which has been paid to the subject.

The trouble which these ground currents from electric railways are causing may perhaps eventually lead to a return to the double-trolley system of electric traction. In this system, as most of our readers doubtless know, there are two parallel overhead wires, placed 12 to 18 ins. apart. One wire leads to the positive pole of the dynamos at the power station; the other to the negative pole. There are two trolley poles on the car roof, one to each wire and the circuit is down one pole through the motors and up the other pole to the return line. The system has been very thoroughly worked out in Cincinnati, and has been in successful operation on street railways in that city for some years. Of course its first cost is considerably greater than the cost of the single-trolley system, when installed in the ordinary way that such systems have been installed, with little or no provisions for the return circuit beyond grounding of the rail and flimsy bonds, which were practically valueless. It is said, however, that if the single-trolley system is built with thoroughly bonded rails and with independent underground wires for the return circuit, equal in conductivity to the outgoing side, the single-trolley system will cost at least as much as the double-trolley system. When it is considered that the double-trolley system absolutely eliminates interference with telephone and telegraph circuits using a ground return, besides preventing all the corrosion of underground pipes, there is much reason for believing that a return to the double-trolley may be the part of wisdom. As we have before pointed out, with even the best provision for the return current which it is practicable to make, a certain amount of leakage is inevitable if the rails are made part of the circuit, since they cannot be actually insulated from the ground. Thus while the danger of the corrosion of underground structures can be greatly reduced, it cannot be wholly eliminated so long as the single-trolley system is used. But for all this the single trolley will remain in use and the difficulties connected with it must be met and overcome as far as possible.

As noted in a recent issue, English engineers have taken warning by experience with electrolysis on this side of the water and the Board of Trade has laid down various requirements for the control of the circuits of electric street railways. In the course of the discussion before the Board of Trade during the drawing of the regulations, the question arose whether the wandering earth current from an electric railway might not reach the track circuit of a block-signal system on a steam railway line, set the signal at safety when it should be at danger, and thereby cause a serious accident. In ordinary signaling practice, the semaphore drops by gravity to the danger position and is raised by an electric current to safety. When it is remembered that the wandering earth current of electric railways is sufficiently powerful to work electric bells and telegraph instruments, and has even, in some cases, we believe, been made use of for incandescent lighting, the possibility that, under proper conditions, such a current might cause a semaphore to show a wrong indication would seem to be by no means remote. It is true that no instance of this sort has thus far been made public; but it is to be remembered that electric railways are still a novelty and little used outside of the United States, and that only a fair beginning has been made in the equipment of this country's railways with block signals. Besides this, many things occur in railway service which are long in being made public, and because no instance of the turning of a semaphore in the manner described is on record, it does not, therefore, follow that none have occurred or may not occur in future.

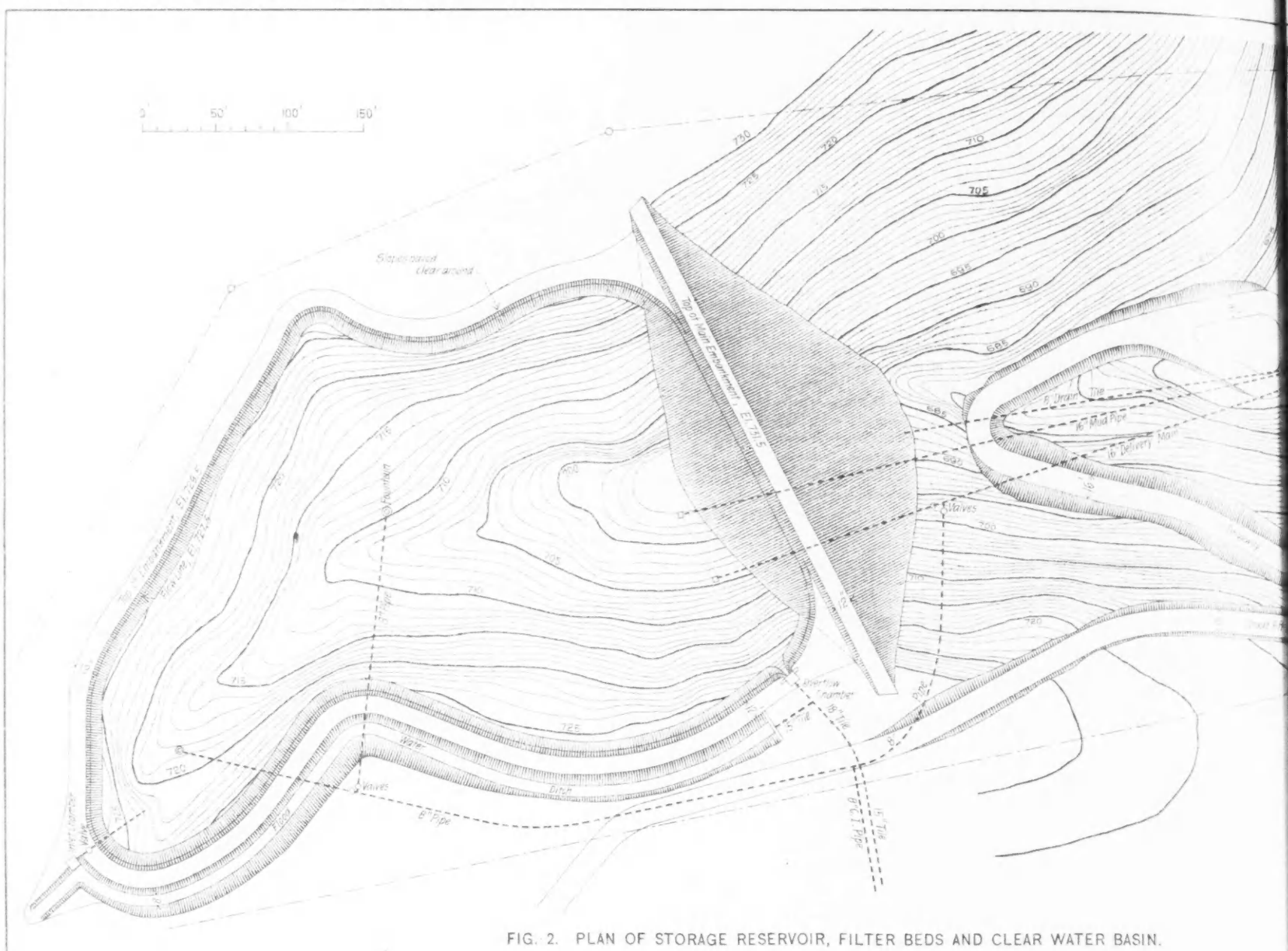
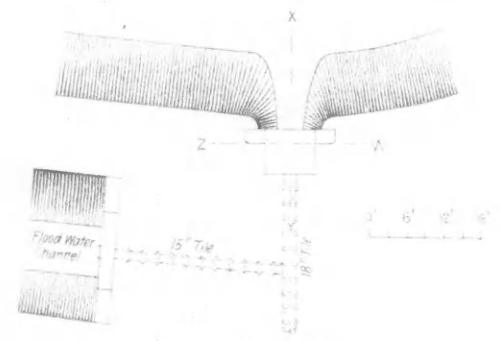


FIG. 2. PLAN OF STORAGE RESERVOIR, FILTER BEDS AND CLEAR WATER BASIN.



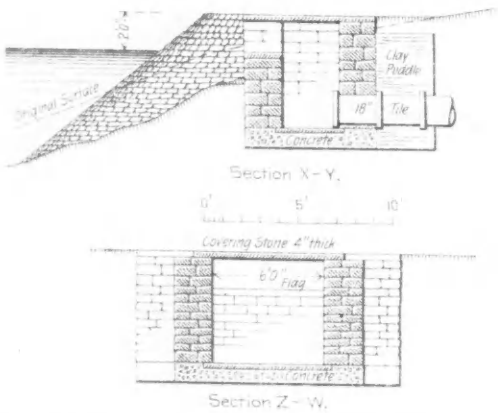


FIG. 3. DETAILS OF STORAGE RESERVOIR OVERFLOW.

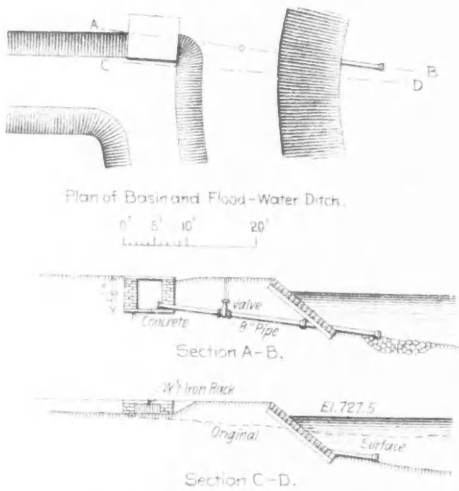


FIG. 4. SPECIAL INLET CHAMBER AND FLOOD WATER DITCH.

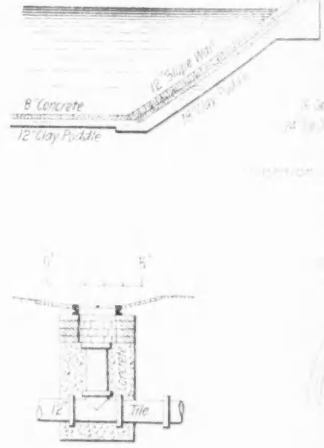


FIG. 6. PARTIAL SECTION OF FILTER AND CLEAR WATER BASIN AND DETAILS OF (SEE FIG. 5)

DIVERTING DAM, STORAGE RESERVOIR, FILTER BED

Stanwix Engineering Co

FIG. 5. DETAILS OF FILTER BEDS AND CLEAR WATER BASIN.

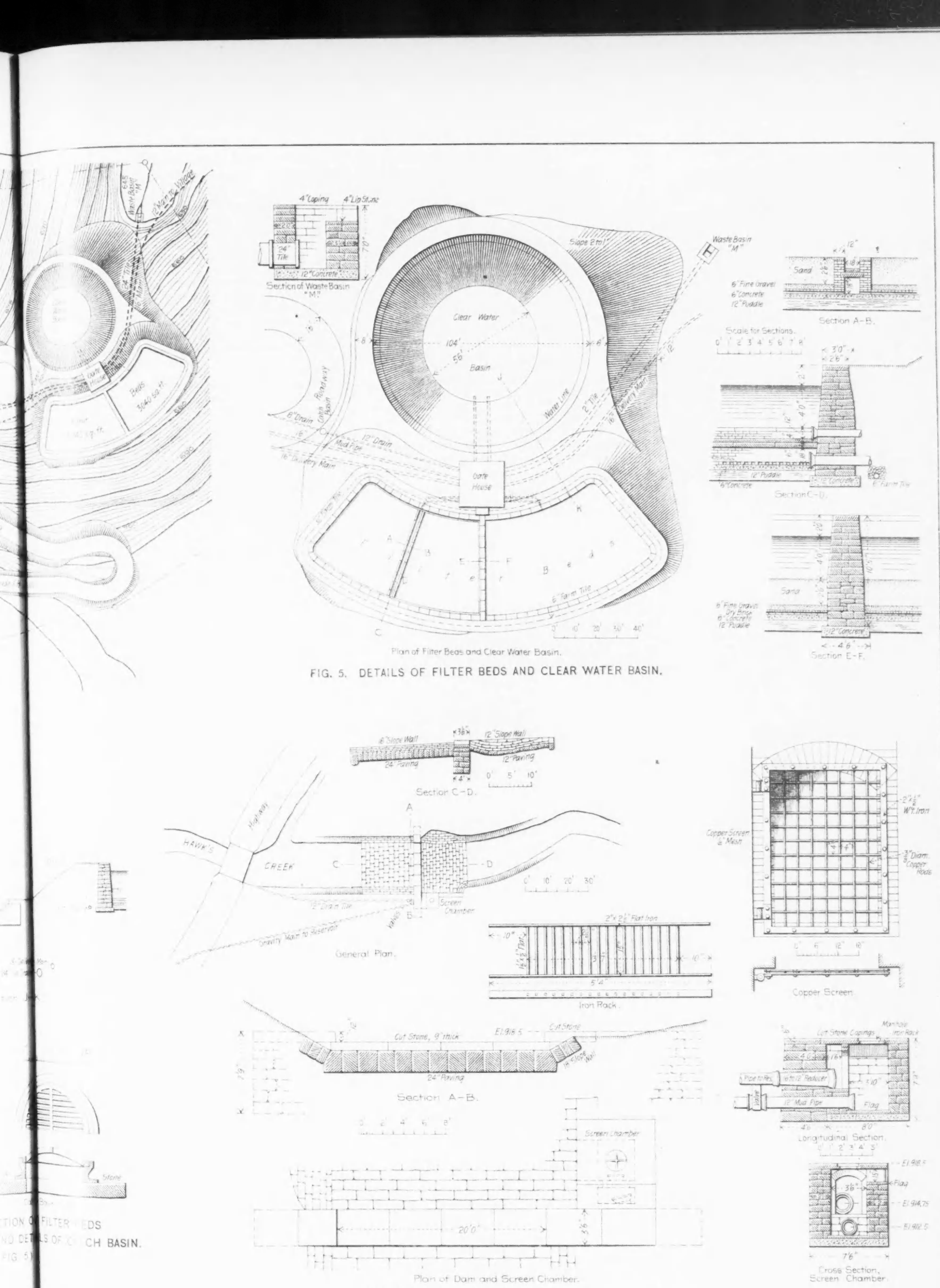


FIG. 1. DETAILS OF DIVERTING DAM.

ILTER BEDS AND CLEAR WATER BASIN, ILION, N. Y.

ineering Co. ngineers.

CHAS. HART & SONS, LITH., 76 VESEY ST., N. Y.

THE TRAMP PROBLEM AND TRAIN STEALING.

Of the many knotty problems which beset the railway manager nowadays, we know of none which more thoroughly defies satisfactory solution than the problem of "deadhead" riding on freight trains. The question has been forced into prominence at the present time by the high-handed acts of the so-called "Coxey armies;" but it should be understood that the train capturing which the various contingents of the Coxey armies have indulged in is the legitimate outcome of the deadhead riding on freight trains which is all the time going on and which is a custom so firmly rooted that its abolition seems well-nigh impossible.

There are two classes of men to be found stealing rides on freight trains. The first is the men who are bona fide laboring men, but who are out of employment and destitute and are traveling in search of work. Such men appeal to the sympathy of the crews of freight trains. Each brakeman makes the case his own and realizes that he may be footing it in search of a job some day. To give a deserving man a lift costs the railway company nothing, he argues; and in spite of ironclad rules, the honest and genuine workingman who is down on his luck is not likely to be refused by the average freight train crew. If the evil stopped here and if there were no deadheads on freight trains save the honest and deserving men actually in search of work and absolutely unable to to pay their fare, railway managers could well afford to wink at such infractions of discipline, but the trouble is that no hard and fast line can be drawn between such men and the professional tramp or "hobo." It is the latter class really, without doubt, that constitute the great bulk of the deadhead passengers on freight trains, and the general public which rides in passenger and parlor cars has little conception how numerous they are. It would be interesting indeed to know just what passenger mileage the movement of "hobos" on freight trains foot up to in a year; but naturally no such statistics are to be had. Some idea of the extent of this travel can be obtained, however, from the very great proportion of freight accidents in which one or more tramps are reported injured, a fact which must impress every one who examines railway accident records.

There are several reasons why freight train crews permit so much riding by professional tramps. Fear is perhaps the most potent cause. Cases of train wrecking by tramps are by no means uncommon, and the trainmen may reason that it is better to let two or three tough-looking customers ride through unmolested than to run the risk of a ditched train by putting them off. Often, too, a band of tramps actually outnumber the train crew, and then discretion may be deemed the better part of valor. Again, it is no easy matter to inspect a long freight train, especially at night, and discover every tramp that may be concealed in empty cars or upon the trucks. If we add to this the fact that not a few sharp wits and good story tellers, who can relieve the monotony of a wait upon a side track, are to be found among the tramps, we have sufficient reasons why professional vagrants are able to ride all over the United States without ticket or pass. Taking all these things into consideration, it is plainly to be seen that the railways alone are not able to cope with the tramp evil, and so long as law makers and law enforcers permit professional vagrants to go and come as they please, so long must the railways carry on their freight trains a large number of these idle and dissolute wanderers. We are fully aware of the extreme difficulty of punishing vagrancy without doing an injury and injustice to the honest seeker for employment, but the problem must be solved before the tramp nuisance can be abated.

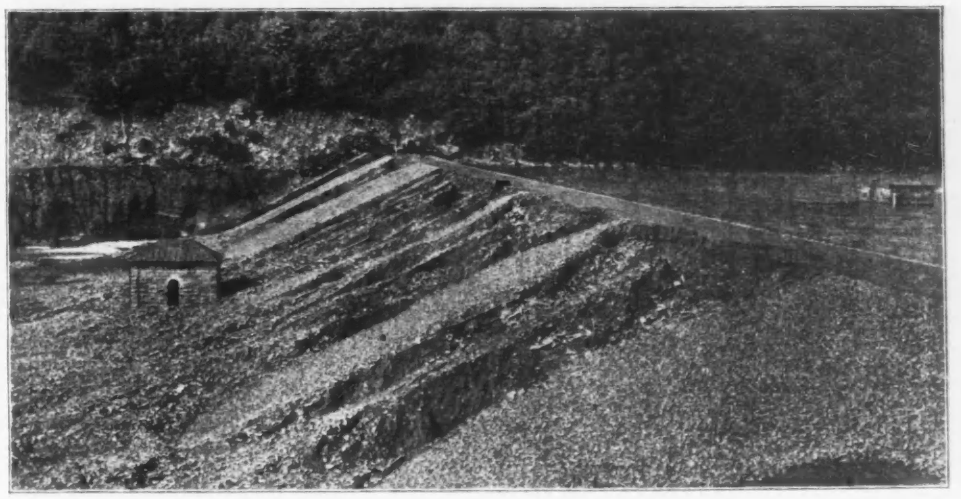
The riding of large bodies of men on freight trains is an outcome, without doubt, of the deadhead riding by ones and twos and threes which has been steadily growing during the past decade. The first extended "capture" of freight trains occurred last summer when the great number of unemployed from the mines of Colorado swarmed eastward to the harvest fields of the prairie states. These men were, largely at least, deserving workingmen. The railways rendered a great public service in carrying to points where employment could be secured the thousands whose overwhelming needs threatened to paralyze the cities of Colorado, but in doing this they established a dangerous precedent, and we may regard the recent train-stealing exploits in the West as resulting, partially at least, from the humane action of the railway managers in last summer's crisis.

Moreover, the precedent once established cannot be rescinded. In future wherever a mob of men is gathered of the classes which lined the tops of the trains bound east from Denver last summer or those who have followed the fortunes of Coxey's lieutenants, we may be sure that the attempt to seize trains will be made, if the mob has any use for trains. It will be seldom that the railway can muster sufficient of its own employees to fight off such mobs, and where it cannot be done the wisest course will be to demand protection from the authorities of city, state and nation. If they fail to give it, they are legally responsible for damage done, and we may be sure that nothing will more quickly enlist the average citizen on the side of law and order than an appeal to his pocket. If the taxpayers have to foot the bills for damages and interruptions to traffic caused by train stealers, the taxpayers will soon find a way to suppress train stealing.

LETTERS TO THE EDITOR.

A NARROW ESCAPE FOR AN EARTH DAM, ALTOONA, PA., WATER-WORKS.

Sir: The accompanying photograph, taken by Mr. Geo. M. McKinney, of the office of the city engineer, of this place, shows the damage by flood at Kittanning Point reservoir, on May 29. The water flowed over the embankment for about 30 minutes, according to the statements of eye-witnesses. Within that time there was a sudden rise of the water, supposed to have been caused by the wind, when for less than ten minutes the depth of the overflow was about 1 ft.



EFFECT OF OVERFLOW ON AN EARTH DAM; ALTOONA, PA., WATER-WORKS.

The area of the Kittanning Point watershed is about nine square miles. The spillway is 5.3 ft. in depth by 34 ft. wide.

Rainfall observations by Dr. Chas. B. Dudley, M. Am. Soc. C. E., show that 4.92 ins. fell from Saturday noon to Monday noon, May 19 to 21, and from Wednesday noon to Monday noon, May 16 to 21, the rainfall was 6.36 ins. Yours truly, H.

Altoona, Pa., May 25, 1894.

(From a sketch plan accompanying the above letter it appears that beginning on the left the first break began 26 ft. from the spillway and extended 90 ft., being about 8 ft. deep; the next break began 64 ft. further to the right, was 139 ft. long and about 6 ft. deep; then followed only 10 ft. of unbroken slope, succeeded by 77 ft. of break about 8 ft. deep; after this and another undamaged 10 ft. to where the final break occurred, about 65 ft. long and 10 ft. deep, terminating some 75 ft. from the right end of the main embankment, which has a total length of about 550 ft., excluding the 34-ft. spillway.—Ed.)

AIR CUSHIONS FOR PNEUMATIC TUBES.

Sir: In your issue of May 10, you say in reporting a paper on the Pneumatic Dispatch System before the Engineers' Club of Philadelphia:

The stored energy of a London carrier while at full velocity is only 9 ft.-lbs., while that of the Philadelphia carriers (Pneumatic Transit Co. of New Jersey) has been as high as 1,380 ft.-lbs. The problems of dealing with the energy were solved by Mr. B. C. Batcheller, the engineer of the company. Air cushions were introduced, the accumulated pressure in the chamber being utilized at the same time to operate, automatically, the receiving apparatus.

We beg to inform you that the United States Government granted to our Engineer, Mr. A. Bryson, M. Am. Soc. C. E., Patent No. 422,498, March 4, 1890, for a receiving device wherein the stored energy of a rapidly moving carrier was utilized to bring it to rest and to operate automatically the receiving device. As this patent covers the case broadly, priority would seem to belong to this company.

Yours truly, Oscar C. Wheeler,
Secy. United States Pneumatic Dispatch Co.
12 Broadway, New York city, May 25, 1894.

(Our description was taken from the bulletin issued by the Engineers' Club of Philadelphia.—Ed.)

THE LUEHRIG GAS MOTOR STREET CAR.

Sir: Referring to the synopsis of my report on "Gas Motors for Street Cars," published in your issue of May 3, the invention therein described has been submitted to careful experiments in London, with such favorable results that an English syndicate has within the past few days purchased the American patents on the Luehrig gas motor car, and will at once take steps to introduce it on a practical scale in the United States. Very sincerely yours, Frank H. Mason,
Consul-General.

Frankfort-on-the-Main, May 21, 1894.

NOTES AND QUERIES.

O. H. P., Rockland, Me., writes: Will some of the draftsmen of long experience in handling mounted papers please give your columns the benefit of their observations on the shrinkage of such papers in "seasoning," and state whether the roll papers show as much change as Whatman's sheets? I have just had my attention forcibly called to the subject by the necessity of adding some work to a plan made in 1893. I found that in one direction the Whatman paper had shrunk an amount equal to 0.3 ft. on each lot of 86½ ft., while in the other direction there was no appreciable change.

An ocean hotel, built on piles at a distance of 14 miles from the Long Island coast, is projected by C. M. Coen, of New York. As described in the daily papers it is to be an iron and glass building, 400 ft. square and two stories high, with the main floor 30 ft. above the water and a fishing floor underneath. Accommodations for 10,000 people are proposed. The cost is estimated at about $3,000,000. The foundations are to be of steel piles, but as the depth of water is given as 200 ft., the construction would be decidedly interesting, and in rough weather the inhabitants would probably wish themselves on solid ground.

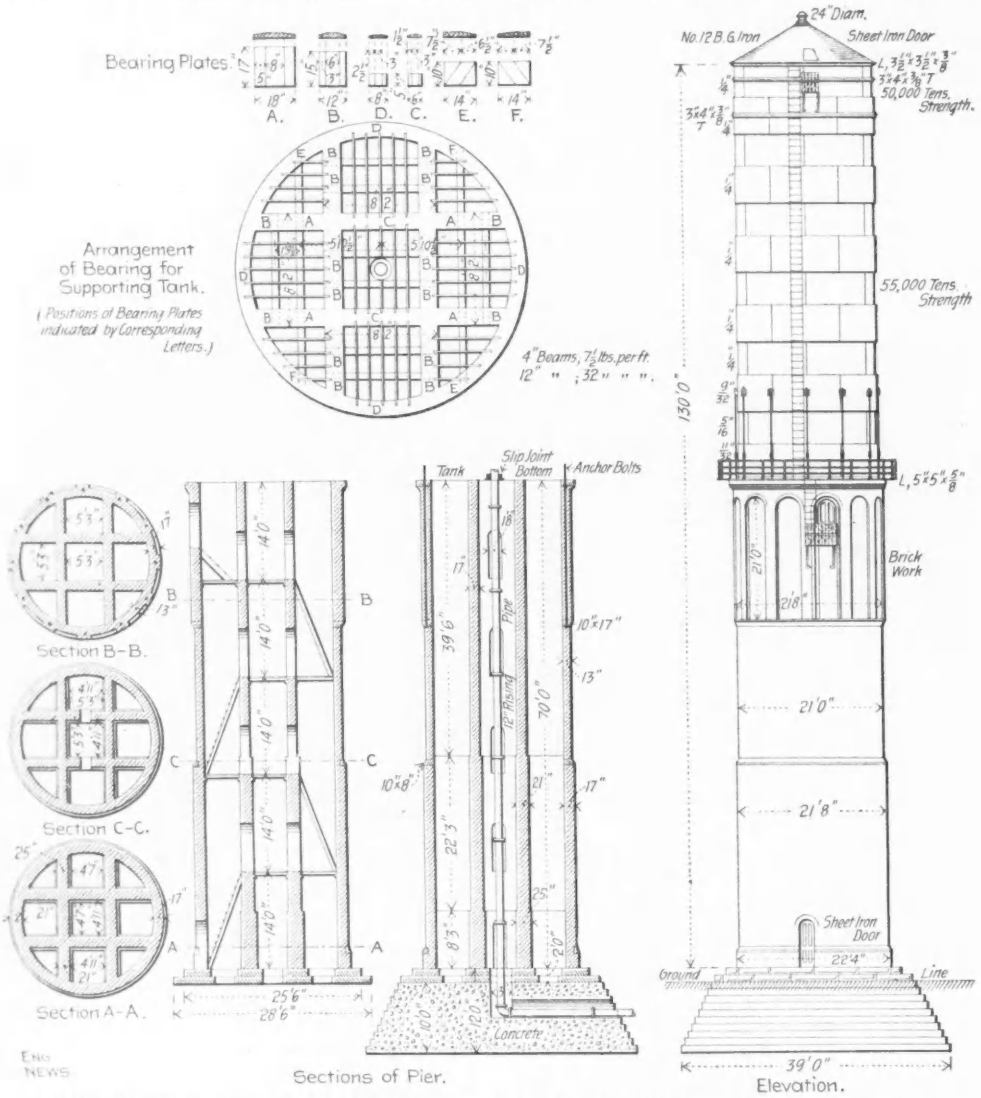
The sewage farm of Adelaide, South Australia, was operated at a slight profit for the year ending June 30, 1893, after allowing for interest on working capital and land rental, according to the last report of the South Australia Public Works Department. Live stock, farm and garden produce, rental of land and grazing charges were the principal sources of income. From Jan. 1, 1883, to June 30, 1893, the total working expenses of the farm, including purchases of stock and plant now valued at $15,600, was about $225,000, and the receipts from the sales of live stock and produce for the same period were about $177,000. Broad irrigation and intermittent downward filtration are employed.

THE WATER TOWER AT GREENVILLE, O.

A 140,000-gallon steel water tank, elevated on a 70-ft. brick tower, resting in turn on a limestone and concrete foundation, was built at Greenville, O., in 1893, with Mr. John W. Hill, M. Am. Soc. C. E., Cincinnati, O., as engineer. Through the courtesy of Mr. Hill we are enabled to give the following illustrated description of the structure: The dimensions and general character of the foundations, tower and tank are shown in detail by the elevation and sections. The concrete was made of one part cement, two of sand and four of broken stone, and has a facing of ring stone 12 ins. thick at the ground line. Common brick were used for the tower, trimmed with hammer-dressed limestone. The holding-down or anchor bolts for securing the tank to the tower are 12 in number, each 1⅜ ins. in diameter and nearly 40 ft. long, upset at the lower ends, as shown in the section and elevation.

It will be noticed that this tower differs from the usual design in that instead of placing all the brick in the outer ring or wall fully half of it is placed in the cross walls, these walls being 4 ins. thicker than the outer wall.

Whether the maximum strength with the minimum expenditure of material was secured by this design is an interesting question, but one which we will not attempt to decide.



WATER TOWER AT GREENVILLE, O. John W. Hill, M. Am. Soc. C. E., Engineer.

The vertical seams in the lower five courses are double riveted, and all the others, vertical and horizontal, are single riveted.

The maximum weight per square foot on the brick due to static load is seven tons and the maximum pressure on the brickwork for a wind pressure of 50 lbs. per sq. ft. is 8.84 tons. The clay on which the foundation is placed sustains a load of 1.8 tons per sq. ft. and rests on a thick stratum of gravel. Mr. F. M. Michael, Eaton, O., was the contractor for masonry. The type of construction chosen was adopted with a view to employing local material and labor as far as possible. The Variety Iron Works, Cleveland, O., were the contractors for the steel and iron work. The masonry cost $6,185 and the tank $3,877, or a total of $10,062 for the structure.

The material employed in the substructure was substantially as follows:

Concrete, cu. yds.	340
Ring course, limestone, cu. yds.	5
Foundation, cut limestone, rock face, cu. yds.	38
Cut stone, belts, etc., cu. ft.	258
Brick, actual solid contents	254,000
Steel floor beams, lbs.	5,000
1⅜-in. holding-down bolts	12

RECOMMENDATIONS FOR STREET PAVING IN BALTIMORE.

Th Baltimore Street Paving Commission, appointed in October, 1893, has reported to the City Council the results of its investigations by correspondence and personal ispection. The commission recommends:

(1) That all streets paved, all streets repaved and all repairs of asphalt and asphalt block pavements be made by contract after due advertisement.

(2) That repairs to all pavements, except asphalt, asphalt block, and the construction and repair of macadam roads, be made by hired labor, unless the repairs constitute a repaving.

(3) That no new or original pavements be laid except with asphalt, asphalt block, granite or brick.

(4) That sheet asphalt pavements be laid upon either a 6-in. concrete base, a 4-in. concrete base or the existing pavements of cobble and rubble.

(5) That asphalt block pavements be laid upon the natural foundation of the roadway, properly rolled, if of satisfactory material; otherwise upon a bed of gravel, properly rolled, at least 5 ins. thick.

(6) That the foundation of granite block pavements, except upon the most heavily traveled streets by prepared as described for asphalt blocks, and that the joints be filled with clean gravel and be pitched with coal tar, paving cement or grouted with Portland cement.

(7) That all brick pavements be laid upon a concrete base, at least 4 ins. thick, and have joints grouted with cement.

(8) That the foundation for all pavements, after being properly graded, be rolled with a roller weighing not less than five tons.

(9) That all pavements be guaranteed and kept in repair for five years by the contractor under such bond or retain as seems best.

(10) That specifications now requiring the use of Trinidad lake asphalt be worded so as to allow the use of any other asphalt which has been found by experience equally as good for paving purposes.

(11) That smooth pavements be laid wherever possible.

(12) That all underground work and sewer and water connections be laid before a street is paved, and that no new pavement be disturbed for one year after its completion.

(13) That no street be opened for any purpose without a permit and a deposit sufficient to cover the cost fo repairs.

(14) That upon future street-railway extensions a full-grooved girder rail shall be used upon all paved streets.

(15) That the cost of the new granite curb, which constitutes part of the sidewalk, be assessed against the abutting property.

(16) That the pavement of streets be made in accordance with the definite plan prepared in advance, showing the character of the pavement proposed to be laid upon each street and the order in which streets should be paved.

The commission visited Philadelphia, Boston, Buffalo and Washington, accompanied by Capt. G. J. Fieberger as advisory engineer. Messrs. James Hodges, David L. Barrett, Charles Goldsborough, D. H. Thomas and H. A. Parr composed the commission.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Power of Council to Make Appropriations.

A charter provision forbidding the council to appropriate any money in excess of the revenue for the fiscal year actually collected, or to bind the city by any contract, or to act to any liability until a definite sum shall first be appropriated for the liquidation of all liability flowing therefrom, does not apply so as to prevent the council from accepting a devise of lands for a public park, subject to an annuity to the widow of the devisor during her life, which is paid by annual appropriation from the general fund; the council being vested by other provisions of the charter with ample power to acquire land for this purpose, either by devise or by actual purchase, to be paid out of the general funds in annual installments.—Budd v. Budd (Cir. Ct., W. D. Mo.), 59 Fed. Rep., 735.

Property Subject to Mechanic's Lien.

A person who furnishes work and material to dredge for a riparian owner in front of his water lot, and to construct docks in front of such lot, has a lien on such structures, and also on the interest of the riparian owner in the lots, and the rights appurtenant thereto, subject to the public right to use the water in which such structures are, for navigation and other lawful purposes.—Williams v. Lane (Supr. Ct. of Wis.), 58 N. W. Rep., 77.

Right of Property Owners to Street.

Where one buys lots according to a plat, showing a street immediately adjoining, he acquires only an easement therefor, and cannot take possession of any part thereof and exclude therefrom the vendor, who has lots on the other side of the street, though the authorities have not accepted the street.—Merrill v. Newton (Supr. Ct. of Mich.), 58 N. W. Rep., 70.

Adverse Possession Against City.

When a person has been in the actual, visible, exclusive and uninterrupted possession of a portion of a street in a city, under a claim of right, for ten years, the title thereto vests absolutely in such occupant.—Lewis v. Baker (Supr. Ct. of Neb.), 58 N. W. Rep., 126.

Powers of Council to Make Contracts by Simple Resolution.

A contract for lighting streets by gasoline lamps, requiring no plant but the posts and lamps, which are to remain the property of the contractors, may be made by simple resolution of council, under the general charter power to make contracts necessary to the exercise of the corporate powers, and further provisions recognizing the power to contract by resolution or order concurred in by a majority of the members elected; and provisions requiring formal ordinances in making contracts for "gas works, electric or other light works," etc., do not apply.—City of Lincoln v. Sun-Vapor Street Light Co. of Canton (Cir. Ct. of Apps., Eighth Circuit), 59 Fed. Rep., 756.

Damages for Deprivation of Water Rights.

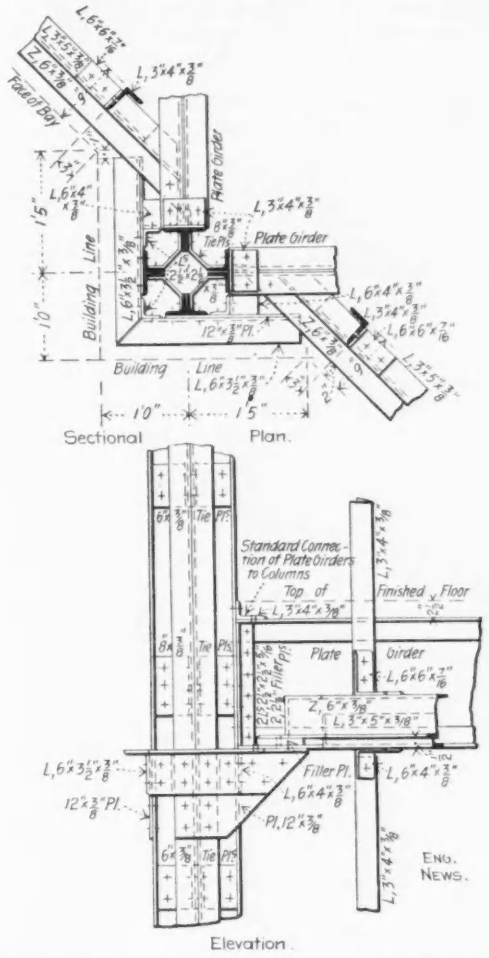
Where the statute empowered a village, in order to increase its water supply, to appropriate such water courses as were necessary within certain limits, and provided for the payment of damages to persons injured by such appropriation, the measure of damages for the taking of water from a stream which supplied power for a mill was the value of the right to the amount of water that could be taken through the pipe the village put in for that purpose, and not what actually was being taken at the time of the recovery. In an action against such village for the appropriation of water which supplied power for the mill, it is proper to show the cost of steam power required to replace the water power lost by the diversion of the water.—Leonard v. Village of Rutland (Supr. Ct. of Vt.), 28 At. Rep., 885.

Fixing Lines of Survey.

The court of Civil Appeals of Texas decides that the lines of a survey in the absence of calls for artificial or natural objects are controlled by courses and distances.—Ratliff v. Burleson (25 S. W. Rep., 983).

WIND-BRACING AND COLUMN CONSTRUCTION FOR BUILDINGS.

We illustrate herewith the column section and outside plate girder system which has been adopted for the Wyandotte Building at Columbus, O., and the Reliance Building at Chicago, Ill., by D. H. Burnham & Co., architects, of Chicago. These particular drawings show a corner column for the Wyandotte Building, with the plate girder and bay window bracing connections. This building has a plan of 62½ ft. × 62 ft. 11 ins., and a height of 150 ft., with 11 stories and an attic and will be used for office purposes only. As will be seen, the construction is the ordinary steel skeleton tall building construction, in which the outside or wall girders have been made extra strong plate girders, with stiff column connections, so as to give the framework great lateral rigidity against wind pressure without the use of an independent system of wind bracing. The connection details of the girder and column are very clearly shown by the drawings. The principle of this extra strong wall girder construction will be readily understood by engineers. Its value



Details of Connection of Girders and Columns, Wyandotte Building, Columbus, O.

for the purpose intended will, of course, depend upon the rigidity with which the girder is connected to the columns and also upon the rigid connection of the columns of one floor to those of the floor above.

According to the specifications for the Wyandotte Building the column connections are to be as follows:

The columns will be made in two-story lengths, alternate columns being jointed at each story. . . . The column splice will come above the floor as shown by the drawings. No cap plates will be used. The ends of the columns will be faced at right angles to the longitudinal axis of the columns, and the greatest care must be used in making this work exact. The columns will be connected one to the other by vertical splice plates. The holes for these splice plates in the bottom of the column shall be punched ⅛ in. small. After the plates are riveted to the top of the columns, the top column shall be put in place, and the holes reamed, using the splice plates as templates.

The form of column used, also shown in the drawing, is the Gray column, patented by Mr. J. H. Gray, of Chicago, in 1892. It consists of four T shapes, made up of angles, which are connected by channel tie plates at intervals along the length of the column. The three corner angles shown in the drawing are reinforcing angles used for this particular column and do not form a part of the normal column section. The manner of connecting one column to another is by splice plates, as described above. The advantages claimed by the inventor for this column are: (1) cheapness of manufacture, (2) simplicity for designing girder connections and other details, and (3) uniform outside dimensions from basement to roof, if desired, without preventing the decrease in sectional area to correspond to the decreasing loads. The manner of obtaining this last feature is very simple. To decrease the sectional area of the column it is plainly only necessary to decrease the size of the angles composing the four T's, which would reduce the outside dimensions of the columns, unless the dimensions of the tie plates were changed. This is what is done. The web of the channel is maintained constant, but the distance between the angle of the web and legs and the center of the rivet hole is increased just enough to shove the smaller T shape out to the required outside dimension. Another feature which is claimed for the column is that it provides space for the passage of pipes from one floor to another inside the column.

The main advantages which the inventor claims, however, are cheapness of manufacture and ease of designing details, and we are informed by those who have used the column that there are very material gains in both of these points. Theoretically, however, it will be seen that the Gray column is not so strong as several other forms in common use. Again, it is evident that, unless the top of the column is very rigidly bound together by outside plates or channels, the girder load is borne mainly by the T shape to which that girder is connected, and not by the whole column section. This may constitute a very serious disadvantage in cases of eccentric loading. We are indebted to Mr. J. H. Gray, Consulting Engineer, of Chicago, and to Mr. E. C. Shankland, of D. H. Burnham & Co., for the matter from which this article and accompanying drawings have been prepared.

THE MOMENT OF GYRATION.

By Benj. F. La Rue.

There is evidently a quite general feeling of skepticism among structural engineers regarding the quantity known conventionally as the Moment of Resistance. Hooke's Law "Ut tensio sic vis," and what is known as the common theory of flexure, are accepted and supported by men of such widely recognized ability that engineers very naturally hesitate to express opinions at variance with them. The writer has for a long time believed that "there is something wrong somewhere" in the form of the moment of resistance commonly used, and in studying the subject has been led toward certain opinions, but has developed no theory. The recent article of Mr. Henry Szlapka on "A New Formula for Bending Stress" (Engineering News, March 22) is much in harmony with opinions formed by the writer, and as this article will probably be considerably discussed, the expression of an opinion, which to some extent appears to be upheld by the results of recorded experiments, is ventured.

That the moment of inertia represents a consistent value from which to obtain the efficiency of any form of section is something which is probably universally conceded; but that when the moment of inertia of a section is divided by the distance from the center of gravity (assumed neutral axis) to the most remote fiber, the quotient will be a quantity which, if multiplied by the unit stress in that fiber, will represent the true resisting moment of the section, is a theory by no means so generally accepted. Assuming the common theory of flexure to be correct, however, it is not difficult to logically deduce for the moment of resistance R, the value $R = \frac{S_0 I}{d}$, in which expression I = the moment of inertia, S_0 = the unit stress in the extreme fiber, and d = the distance of that fiber from the neutral axis. But it is a well-known fact that when this value $\frac{S_0 I}{d}$ is substituted for the actual resisting moment developed in sections of various shapes, as ascertained by tests, and the value of S_0 computed from it, the value thus derived not only varies in different shapes of the same material, but it is almost invariably greater than the lesser value of the material in direct tension or compression. In round sections the value of S_0 as thus derived is usually about double the lesser (tensile or compressive) strength of the material. It is true that if the value of the extreme fiber stress is in each case based upon tests not only of the same material, but of the same shapes of the same material, the computed results will be reliable; but this would be true of a purely empirical formula and proves nothing, except that the same shapes of the same material have practically the same values of S_0. It is impossible to give a satisfactory reason why a round section under transverse stress should develop strength in the extreme tensile fiber double its actual strength in direct tension. On the other hand, it is very reasonable to assume that the strength of the material is practically no greater, and, therefore, that the stress at rupture is practically no greater, in one case than in the other. But if this is true, then the conditions of the common theory of flexure and of the formula $S_0 = \frac{R\,d}{I}$ cannot exist at rupture.

It seems to be habitual among investigators to work upon the hypothesis that the common theory of flexure must be correct because it has been deduced by processes of mathematical reasoning which appear logical; and, if the results of a series of tests do not agree with the theoretical results, to attempt to amend the theory and explain the inconsistencies by attaching new conditions.

Prof. Johnson, in his discussion of Saint Venant's theory,* gives equations proposed by the latter "Which prove to be capable of expressing the strength of a beam at rupture very closely." The curves given by the equations (which, if the writer comprehends them correctly, represent the proportional magnitudes of the stresses at rupture) show that the stresses vary across the section in a manner distinctly different and more uniform than is assumed in the common theory. But Prof. Johnson states that "Within the elastic limit * * * * Hooke's law holds true," and emphasizes the statement that "For all bending within the elastic limit the stresses are uniformly varying across the section." In short, the general theory of flexure supported by prominent writers is that the common theory holds correct within the elastic limit, but that "Beyond this (elastic) limit the stress does not increase as rapidly as the strain" and the proportional magnitudes of the stresses assume the forms indicated by Saint Venant's curves, presumably more and more distinct as the point of rupture is approached. This at present appears to be the popular theory of flexure, and Prof. Johnson is quoted above simply as voicing a popular theory and not as advancing a personal opinion.

It is probably true that the strain is much more nearly proportional to the stress within the elastic limit than beyond it; but this does not explain why the error of the common theory gives a value for S_0 about 100% too large in case of a round section, and only about 25% too large in case of an I-section; this very prominent inconsistency in the common theory is not explained by stating that the strain is proportional to the stress within the elastic limit and not proportional beyond it. Although it is a merely speculative opinion, the writer believes that observations of the elastic limit in a series of systematic transverse tests upon material having a well defined elastic limit would show the common theory to be in error at the elastic limit as well as at rupture, though, perhaps, to a less extent. If the common theory were set aside as inaccurate and inconsistent, and a more consistent theory sought from a standpoint unprejudiced in favor of any theory, it is not improbable that a more consistent one could be found. But it may be pertinently remarked that this is a thing more easily suggested than accomplished, and that the common theory should at least be retained until a better one is found.

An appreciable analogy exists between a beam that fails by flexure and a column that fails by violent deflection. That the least radius of gyration is a more consistent quantity to use in computing the efficiency of columns than is the least diameter, is probably so well established as to be unquestioned.

* Theory and Practice of Modern Framed Structures.

It may be well to notice whether the radius of gyration may not with consistency be substituted for the distance from the center of gravity to the most remote fiber in deducing the resisting moment of beams.

The centers of gyration for any section, with respect to an axis through the center of gravity, are those two points at which, if all the material on the respective sides of the axis were concentrated, the moment of inertia (and the efficiency of the section) would be the same as in the original section. The distance between these points is the radius (combined radii) of gyration of the section. Is not this distance the mean lever arm of the resisting moment of the section?

The value of the moment of inertia I for any section may be written $I = \Sigma a r^2$; in which a = one of the equal elementary areas into which the section may be conceived to be divided, r = the distance of each area from the axis, and Σ is the sign of summation. As Σa = the area of the section, $\Sigma a r$ = the area of the section multiplied by the mean lever arm of its resistance; and if S_m = the mean fiber stress upon a unit of area, then $S_m \times \Sigma a r$ = the true moment of resistance of the section. But the radius of gyration $r = \sqrt{\frac{I}{\Sigma a}}$, and $S_m \times \Sigma a r = \frac{S_m I}{r}$ = the moment of inertia multiplied by the mean fiber stress and divided by the radius of gyration. Or, if $I = \Sigma a r^2$, then $\frac{I}{\Sigma a} = r^2$ = the mean square of the lever arm and r = the mean lever arm of the resistance of the section. The product of the mean unit stress, the area and the mean lever arm $= S_m \times \Sigma a r = \frac{S_m I}{r}$ = the moment of the stresses, or the resisting moment of the section. This quantity $\frac{S_m I}{r}$ will for distinction be called the moment of gyration; it is not improbable that it will be found to more closely approximate the true resisting moment of a section than what is known as the moment of resistance. The mean fiber stress does not definitely indicate the intensity of the stress in the extreme fiber, which is probably the maximum and critical stress, but available evidence indicates that it approximates very much nearer to the maximum stress than is generally believed, or is assumed in the common theory.

In 1855 Barlow published a theory in which he attempted to show that the fibers in a beam cannot act independently, but that through the ability of the material to resist longitudinal shear the adjacent fibers influence each other; the fibers which bear greater stress are sustained by those which bear less stress, so that the stresses are more evenly distributed through the section than is assumed in the common theory. Whatever may have been the errors in Barlow's theory, the writer believes it to have been a step in the right direction. The Navier or Saint Venant theory practically sustains Barlow's theory as being in a general way correct at the point of rupture.

If at rupture and beyond the elastic limit the stresses are not in proportion to their distances from the neutral axis, there is a reason for it; and it may be consistently assumed that this reason is the ability of the material to resist longitudinal shear. The most remote fiber, for instance, is strained more and elongates more than the adjacent fiber, and as a result of this difference of elongation, shear is developed between the fibers, to which the material offers a resistance. To just what extent shearing stress is developed, or to what extent it influences the stresses in the adjacent fibers, is not clear; but that longitudinal shear is developed between the fibers is quite certain, as proved by tests of timber beams which not uncommonly fail by shearing longitudinally. That the shearing in such cases is caused by the applied force is, of course, beyond question; and, therefore, the resistance to longitudinal shear is a resistance to the force applied to cause flexure. How much the stress in the extreme fiber is sustained by the adjacent fiber is uncertain, or at least unknown; the amount probably varies in different materials to such an extent that the stress in the extreme fiber becomes a rather uncertain quantity. The writer believes the mean fiber stress to be a more reliable quantity. If in the quantity $\frac{S_m I}{r}$, which has been designated as the moment of gyration, the mean unit stress S_m be given the lesser value of the material in direct tension or compression, it is believed that the stress in the extreme fiber will be so little in excess of the allowed mean stress that, with a reasonable factor of safety, the excess may be safely ignored.

In Mr. Szlapka's article, previously mentioned, he concludes that "If a body may be strained by the amount S for each unit of its section in direct tension or compression, the strain per unit of the extreme fiber of the same body subject to flexure may be taken as S_1"; after deducing the value $S_1 = \frac{S d}{r}$, in which r = radius of gyration and d = distance from the neutral axis to the extreme fiber. The value S_1 is to be given to the unit strain in the extreme fiber in the usual formula for the moment of resistance; or, in other words, the moment of resistance R is to be written $R = \frac{S_1 I}{d}$. The writer has endeavored to show that the true resisting moment, or moment of gyration $= \frac{S_m I}{r}$; and has ventured the statement that the actual maximum stress is so little in excess of S_m, that the excess may be safely ignored and S_m be given the lesser value of the material in direct tension or compression, i. e., the value S as used by Mr. Szlapka. As the two expressions for the resisting moment must, if correct, be equal, therefore,

$$\frac{S_m I}{r} = \frac{S_1 I}{d}.$$

According to Mr. Szlapka's conclusions $S_1 = \frac{S d}{r}$, and substituting this value for S_1 in the above equation,

$$\frac{S_m I}{r} = \frac{S d}{r} \times \frac{I}{d}, \text{ and } S_m = S;$$

or, if Mr. Szlapka's conclusions and those of the writer are correct, S_m may be given the lesser value of the material in direct tension or compression.

These conclusions, which have been arrived at by processes of reasoning radically and entirely different, and are really different conclusions, harmonize thoroughly in their results. If either conclusion is correct, it eliminates many prominent inconsistencies from the expression for the resisting moment of a beam. The moment of gyration (which is practically Mr. Szlapka's modification of the moment of resistance) possesses the decided advantage of being consistent for any section; it does not require the unit stress to be varied for different shapes of the same material.

It will be well to notice how nearly the values of S_m, computed from the results of experiments by means of the moment of gyration, agree with the values of S in the results of corresponding experiments. In the accompanying table are given experiments which afford reliable comparison between the strengths of the materials under direct stress and under transverse stress. The values compared are in each case the results of tests made by the same experimenter and were presumably made upon the same qualities of material. It is regretted that no tests of wrought iron, affording just comparison, were available.

In the experiments on cast iron and the qualities of steel quoted, the average of the mean fiber strain is only 1% less than the value of the material in direct tension, or practically the same. In the cast iron experiments it is especially noticeable that whereas the modulus of rupture is very much affected by the shape of the section, the mean fiber strain is not materially affected, but in each shape agrees closely with the tensile strength.

In rolled I-sections the ratio $\frac{d}{r}$ varies from about 1.24 to 1.27; but the rolled I-section varies from the cast section, as the latter usually has rectangular flanges. The ratio 1.28, given in item 4, was computed from an assumed section 4 × 4 ins., having rectangular flanges and metal ½-in. thick. The ratio $\frac{d}{r}$ varies so greatly in T-sections that it was thought inexpedient to attempt to compute it without knowing the dimensions of the sections tested. The ratio given in item 5 is the ratio of rolled sections agreeing most nearly with the ratio $\frac{S_o}{S}$ in the same item.

In Bauschinger's experiments with steel of higher percentages of carbon than those quoted, it is noticeable that whereas the tensile and compressive strength is materially increased by the addition of carbon, the modulus of rupture is increased but little, if any. For instance, with 0.80% and 0.87% of carbon the modulus of rupture is less than with

TRANSVERSE STRENGTH OF CAST IRON, STEEL, TIMBER AND CEMENT COMPARED WITH THE STRENGTH OF THE SAME MATERIALS IN DIRECT STRESS.

Ref. No	Material.	Shape of section.	Number of tests.	Modulus of Rupture, S_o. Lbs. per sq. in.	$\frac{d}{r}$	Mean fibre stress, S_m. Lbs. per sq. in.	$\frac{S_o}{S}$	Number of tests.	Ultimate strength in direct stress, S. Lbs. per sq. in.	$\frac{S_m}{S}$	Experimenter.
									Tension.		
1.	Cast iron	Round.	5	48,164	2.00	24,082	2.00	5	24,030	1.00	*B, C and R.
2.	" "	Square.	3	40,583	1.73	23,430	1.70	3	23,816	.98	C and R.
3.	" "	Rectangular.	5	40,268	1.73	23,250	1.67	5	24,118	.96	B, C, S and R.
4.	" "	I-section.	4	29,650	[1]1.28	23,164	1.29	4	23,110	1.00	B, C and R.
5.	" "	T-section.	4	27,302	[2]1.21	22,562	1.24	4	21,970	1.03	C, S and V.
6.	" " remelted	Rectangular.	4	42,216	1.73	24,370	1.65	4	25,592	.95	Wade.
									Comparison of 25 tests,	.99	
7.	Cast st'l, Scotland S. Co.	Rectangular.	8	99,859	1.73	57,660	1.52	..	65,520	.88	Ravenhill.
8.	Hammered crucible steel.	"	..	147,841	1.73	85,360	1.78	..	82,992	1.03	Kirkaldy.
9.	Steel, .14% carbon	"	..	112,600	1.73	65,100	1.79	..	63,000	1.03	Bauschinger.
10.	" .19% "	"	..	122,300	1.73	70,700	1.80	..	68,050	1.04	"
									Comparison of (?) tests,	.99	
									C'mpr's'n.		
11.	White oak	"	36	5,863	1.73	3,385	1.67	4	3,506	.96	Lanza.
12.	" pine	"	37	4.451	1.73	2,570	1.49	6	2,992	.86	"
13.	Yellow pine	"	51	7,486	1.73	4,322	1.60	8	4,676	.92	"
14.	Pitch pine	"	5	7.854	1.73	4,535	1.68	5	4,689	.97	Kirkaldy.
15.	Baltic red pine	"	3	4,878	1.73	2,816	1.99	3	2,445	1.15	"
16.	Eight varieties of timber	"	(8)	11,331	1.73	6,542	1.71	(8)	6,614	.99	Laslett.
17.	Six varieties of timber..	"	45	7,714	1.73	4,454	1.38	45	5,606	.79	Bauschinger.
18.	Four varieties of timber.	"	32	5,691	1.73	3,286	1.56	4	3,658	.90	"
									Comparison of 150 tests	.88	
19.	Cement	Square.	896	....	1.73	....	1.83	542	....	1.06	Abbott & Mor's'n

* B, Bach; C, Considere; R, Robinson and Segundo; S, Sondericker; V, Burgess and Viele.
[1] Varies from 1.24 to 1.28. [2] Varies from 0.86 to 1.21.

0.14% and 0.19%, while the strength in both tension and compression is nearly twice as great in the former as in the latter. As this appears to indicate some law which has not been considered, only the experiments with low carbon were quoted. The experiments of Major Wade with cast iron under prolonged fusion and under different conditions of casting show somewhat similar results. As the development of any theory is not attempted in the present article, the significance of these conditions will not be considered.

A good comparison of the strength of timber under transverse stress and under direct compression is obtained from the results of the experiments given. The number of Laslett's experiments, item 16, are not known to the writer; if the number is more than eight it would bring the average value of $\frac{S_m}{S}$ nearer unity. From the results obtained it appears that for timber the mean fiber strain at rupture is 88% of the compressive strength.

Messrs. Abbott and Morrison have made a large number (1,438) of tests to determine the relative transverse and tensile strength of various cements (Engineering News, Dec. 14, '93, and May 10, '94), which afford very reliable comparison of the strength of this material under these two conditions (item 19). The average of the comparison in this large number of tests, in which average each result is given weight according to the number of tests which it represents, shows a ratio of 1.83 between S_o, the modulus of rupture, computed by the common formula for the moment of resistance, and S, the actual tensile strength of the material. The ratio between the mean fiber strain S_m, computed by the moment of gyration, as given above, and the tensile strength is 1.06. This ratio is as near unity as any comparison between results obtained by a formula and the actual results could be expected to be in this material; it would indicate that in transverse tests of cement the mean fiber strain S_m, as computed by the moment of gyration, may be considered to correctly express the tensile strength of the material. In the table the average modulus of rupteure, mean fiber strain and tensile strength are not given for cement; the ratios given were computed directly from the ratios "C" given by the experimenters.

A more complete knowledge of this subject is very desirable; a series of systematic experiments might do much toward obtaining it.

THE WORKS OF THE WATER AND LIGHT CO., COLUMBIA, MO.

By Hiram Phillips, Assoc. M. Am. Soc. C. E.

The plant of the Columbia Water & Light Co. was built during the period from March to September, inclusive, 1893, under a 20-year franchise granted to W. F. Anderson, of St. Louis. The franchise provides for the purchase of the works by the city at the expiration of 10, 15 and 20 years and fixes the minimum water rate at the St. Louis rate for the year 1892. The franchise calls for 6½ miles of water mains and 48 double fire hydrants, also for ten 2,000-c. p. arc lamps, burning until 11 a. m., and twelve 32-c. p. incandescent alley lamps, to burn all night.

The pumping plant and central station include the following apparatus: Two Deane pumping engines, one a compound for general use and the other a simple for fire service, each pumping direct; two Fisher pressure governors, two 5½ × 16-ft. Springfield tubular boilers, one Hoppes feed water heater and one Blake feed water pump, a 150-HP. Armington & Sims engine, a 1,300-light 16-c. p. Westinghouse alternator and a 40-light 2,000-c. p. Ft. Wayne arc dynamo.

For the distribution system pipe was bought from Shickle, Harrison & Howard, of St. Louis, and Empire compression hydrants and Scott valves were used.

The water supply is drawn from Huckson Creek, where, for storage purposes, a masonry dam, shown in the accompanying view, 300 ft. long on top and 22 ft. high, was constructed. The dam is 14 ft. thick at the base and 6 ft. at the top, the face of the dam being laid to a batter of 1½ ins. per ft., the coping stones projecting 6 ins. over the face of the dam. The foundation of the dam was set 6 to 12 ins. in solid rock and Utica cement mortar was used throughout.

The coping stones of the dam were made of white limestone 6 ft. long and not less than 3 ft. wide and 8-ins. thick, bush-ahmmered and lain to a ½-in. joint. The dam is provided with two 3 × 5-ft. sluice gates, operated with a screw. The intake pipe is cast iron and laid through the dam. The pumps are placed in a pit below the dam, so that when the reservoir is full there is a head of 15 ft. on the pumps. Some little trouble was encountered in adjusting the valve springs, but this arrangement has proved very satisfactory.

HOISTING APPARATUS OF CANAL HEAD GATES; SEWALL'S FALLS, N. H.*

By John R. Freeman.

These gates are of interest from their large size and the ease and rapidity with which they can be raised and lowered by the hand power of one man. They are situated at the head of a water-power canal, at Sewall's Falls, on the Merrimack River, near Concord, and it is designed that ultimately the whole ordinary flow of the river shall pass through them. The natural flow, reinforced by the draft from the storage reservoirs, amounts in the dry season to 1,000 cu. ft. per second for 24 hours. As there will be night storage in the dam, and the head will be at times reduced by back water, there may be a maximum flow of 2,000 and possibly 3,000 ft. The floor of the sluiceways is 10 ft. below the crest level of the permanent dam, and the top of the archway is level with top of flash boards.

DAM FOR THE WATER-WORKS OF COLUMBIA, MO.

The dam may in time be raised 3 ft. The greatest known freshet would cause a depth of 10 ft. on the crest. To allow carrying the water at greater height during freshets and offsetting in part the loss by back water, the banks of the canal are built higher than is customary.

On account of quicksand being encountered, the foundation for the sluiceways was difficult. The whole space was, therefore, inclosed by 6-in. tongued and grooved sheet piling, 16 ft. long. On this was laid a floor 3 ft. thick of old railway rails and concrete, and other rails were inserted as ties in the masonry above the arches, thus making the whole mass rigid. Wing walls were also built, resting upon lines of sheet piling. To resist scour, a plank apron was extended 25 ft. up stream, with sheet piling across its upper end, driven to a depth of 6 ft. A plank floor was to have extended 180 ft. down stream, but it has been shortened.

The sill on which the gates shut is a massive girder-shaped iron casting, extending under the piers and embedded in concrete. It is not planed, but very carefully cast to true form and smooth surface. The cast iron pier faces, against which the gates slide, are not planed. Machine work was avoided as far as possible, to reduce cost. Each gate has a clear width of 10 ft., and height of 12 ft. from sill to top of arch. The object of the paper is to show the method of reducing friction on the gates, so that they can be handled by one man. The pressure with a full pond and empty canal is 40 tons, and it was probable that the sliding friction, together with three tons for the gate and attachments, might amount to 20 tons.

To make the movement easy and avoid the great friction, the gate is carried on four cast iron truck wheels, 18 ins. in diameter, which run on a cast iron track formed of the same piece with the pier face. When the gate is entirely closed, the wheels are thrown out of contact by a depression of ½-in. in the tracks, allowing the gate to drop into close contact with the pier faces and sill. In starting to open the gate, the pull will be the same as on an ordinary gate. This is overcome by the temporary use of a long lever, but as soon as the truck wheels get a firm bearing, the sliding friction disappears, and the rest of the raising is done with a hand crank. Each wheel may have to carry a 10-ton load, and the axles were made 5 ins. in diameter. As they cannot be oiled, 1-in. roller bearings of Tobin bronze were used.

The hoisting gear consists of a 4-in. solid forged machinery-steel shaft on which the worm is cut, and a cast worm-wheel which is much smaller than is ordinarily used, thus giving greater leverage. Ball bearings are used for the worm shafts. The gates can be run up above ordinary water for repairs, and electric power can easily be applied, if desired. One revolution of the crank lifts the gate ¼-in.

* Abstract (from Society's bulletin) of paper to be presented at the convention of the American Society of Civil Engineers at Niagara Falls. The dam was described and illustrated in our issue of April 19.

THE MARKING OF STREET LINES.*

By C. M. Broomall.

This paper is a summary of the results of inquiries made among city engineers in all parts of the country as to the methods pursued by them of marking street lines. The commonest method is by the use of stone monuments of either granite or marble. The ordinary length is 18 to 24 ins., although some cities use lengths of 3 to 5 ft. Erie, Pa., uses stones of 1 ft. cube, with a copper rivet inserted to mark the line. Artificial stone is used in Jacksonville, and brick protection boxes with iron covers in Salt Lake.

Iron bolts from 1 to 1½ ins. in diameter, and 1 ft. to 2½ ft. long are used in some cities. These are driven at the intersections of the center lines. In Memphis 30-in. bolts, with 2-in. square heads, protected by 6 × 20-in. iron cylinders with a cover, are used; also limestone monuments. Albany, N. Y., uses 3-in. cast iron pipe 5 ft. long, with brass cap having a central hole, to mark the point. In Salem, Ore., two stones, 10 and 24 ins. long, are set one over the other, each centered, and a quart of charcoal used at the junction. As to bench marks, all sorts of objects, water tables, door-sills, copings, hydrants, iron bolts in roots of trees, etc., are used. The datum planes are equally various. In this connection it is stated that the average level of Lake Erie Canal at Cleveland is now 2 ft. less than it was in 1854.

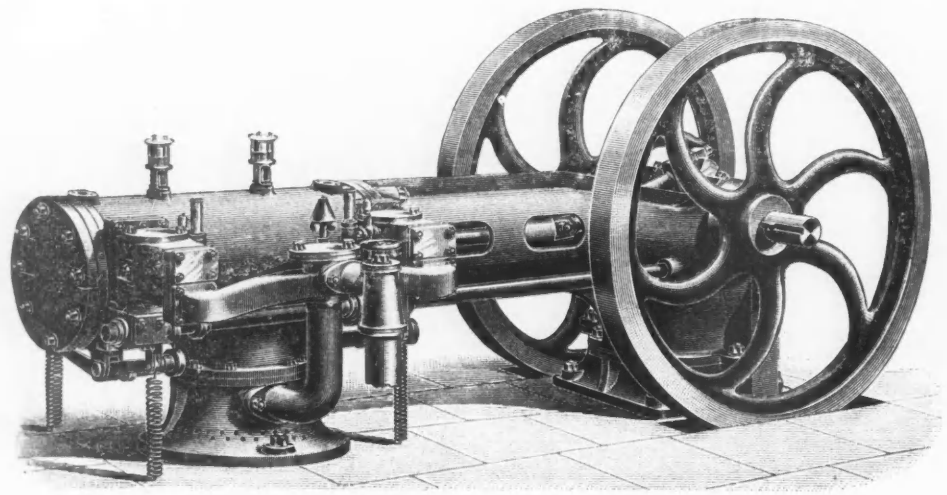
The author's experience at Media, Pa., shows that stone monuments 18 to 24 ins. long are gradually changed in line and level, as a result of frost and wet. Where stone monuments are used, the following dimensions are recommended: 5 ins. square at top for 6 ins., then increasing to 10 ins. square at the end of a total length of 3 ft. A hole to be drilled in the top for

* Abstract (from Society's bulletin) of a paper to be read at the convention of the American Society of Civil Engineers at Niagara Falls.

the range. The stone to be set 5 ft. from either side line of the street, with the top just below the sidewalk, and covered with a loose brick or tile. Where iron is used, to be set on 5-ft. range lines, and consist of double-hubbed, tarred, cast-iron 4-in. pipe, 5 ft. long, with a lettered brass cap, having a hole in it for range mark, and set as last described. Such monument will cost about $2 to $2.25, or about half that for marble, and is more durable. The stone has the greater weight, and will resist best the disturbing forces.

DOUBLE-ACTING GAS ENGINE.

Gas engines are very much more used in England than in this country and the demand for gas engines of large power, more especially for large electric light plants, has led to rapid development and improvement in these engines. The firm of Dick, Kerr & Co., of London, has made a specialty of the perfection of internal combustion engines especially adapted for cheap generator gas, or producer gas, such as made by the Dowson fuel process, which was introduced in this country a few years ago, and the use of which has become popular in Great Britain, both for furnishing gas for motive power and for other purposes. The firm has brought out double-acting and tandem engines that have



DOUBLE-ACTING GAS ENGINE.

proved very satisfactory in service, and in these engines the working impulses are more numerous and the pressures are claimed to be less suddenly developed and more thoroughly sustained during the working stroke than is the case in other gas engines.

The double-acting engine has the cylinder closed at both ends, the piston rod passing through a stuffing gland in the front cylinder cover, thus closely resembling in general appearance the ordinary type of steam engine. When working under usual conditions, an explosion in the back part of the cylinder making an out-stroke is, on the in-stroke, followed by an explosion at the front end of the piston, the two consecutive combustions being followed by two idle strokes, when a compressed combustible charge ready for firing is again at the back of the piston, while a combustible charge ready for compressing fills the space in front. There are thus double the number of impulses in a given time per cylinder as in a single-acting Otto cycle engine making an equal number of revolutions; hence, other conditions being equal, each impulse requires but half the pressure necessary in the single-acting engine of equal horse power.

In the accompanying cut is shown the ordinary type of motor made by this firm, being a double-acting Otto cycle of 150 I. HP. at 160 revolutions per minute. The gas and air pipes are kept clear of the cylinder, so as to allow a free circulation of air around the heating parts. The valves are easy of access. In the original Griffin engine, upon which these engines are largely based, ignition was effected by a flame and plain slide valve, with a small chamber containing gas under pressure, but tube ignition is now employed. The engine is self-contained and requires but a small foundation. Coupled engines, with cylinders placed side by side, are made in sizes of 100 to 300 HP.

The tandem engine, designed especially for electric light plants, is equally as steady as the coupled engine, while it occupies less space and is self-contained. The timing of the ignitions and the composition of the combustible charges are so arranged as to lessen the initial pressure of explosions. The governor controls air supply as well as gas supply, so that the regulation of speed under varying load is effected by gradual alteration of the explosive strength of the mixture admitted into the cylinder, and not by abrupt cessation of working impulses, the governor not cutting out until the working load is reduced to about one-third of the maximum. This enables the engine to work under great variations of load as smoothly and evenly as a steam engine.

Prof. Jamieson, of Glasgow, reported as follows on this engine:

The engine in its general style and behavior more closely resembles an ordinary double-acting steam engine than any other gas engine with which I am acquainted, for both ends of the cylinder are closed in, and an impulse is given to the piston every one and a half revolutions, i. e., combustion takes place at each end of the cylinder alternately every three revolutions of the crank shaft when the engine is working under normal conditions. This feature naturally causes the speed of the gas engine to be more constant than single-acting gas engines, and therefore better adapted for driving dynamos or other machinery where constant speed is required. Throughout the whole of my electrical test the engine worked very steadily; in fact, I have never before tested a gas engine which maintained such uniformity of speed at full power, no pulsation or blinking being observable in the incandescent lamps. The engine is very powerful for the so-called nominal horse power (a term still common among gas engine makers); in fact, it develops very nearly double the nominal horse power on the brake. The absolute and practical efficiencies or ratios of indicated horse power and of brake horse power to gas consumption in terms of heat units are, respectively, equal to 19.2% and 15.1%, which results are better than I have obtained from any other gas engine.

The contract for the manufacture of these engines in the United States has been secured by Mr. W. W. Goodwin, of Philadelphia, Pa., and the American Gas Engine Co., of Bordentown, N. J., has been organized to manufacture the engines, with Mr. Goodwin as president, but arrangements have been made to import the engines until the works are in operation.

NOTES ON WIRE ROPE TRAMWAYS.*

By A. C. Savage.

It is a well-known fact that both single and double rope systems of wire rope lines are in general use. The single system is the older and better known. This is again divided into two systems, one in which the buckets are detached from the ropes at the terminals, and the other where the buckets are fastened to and carried by the rope around the terminal wheels, and are loaded and unloaded in the transit. This system is less expensive than the other, and where the output is small there is an advantage in first cost. When, however, the production approaches the limit of capacity, repairs and stoppages become frequent and a matter of unceasing solicitude to all parties. It is frequently the case that both buyer and seller are thus injured, and the reputation of a really good machine is damaged by its improper use.

The double rope lines have the advantage that, with proper designing and construction, they have a much greater capacity, and by skillful adjustment the repairs are reduced to a very small amount. The designing of such a line is seldom a simple piece of work, on account of the difficulty of a good location for one or both of the terminals, as well as the irregularity that is necessarily introduced in the distances between supports, the ideal distance being 150 to 200 ft. Other difficulties are the heavy grades into or out of the terminals, and intervening summits on the line, or hollows of considerable width. The upper terminal for the standard 8-ft. line requires a width of 20 to 24 ft., and a length of 60 ft. Room should be left behind for switches, on which empty cars can stand.

An instance of a difficult location for the upper terminal occurred at the Ground Hog Line, and the only available spot on the mountain side was selected. The outgoing grade was 60%, and it was impossible to support the line at the immediate foot of the bluff on account of its being in the track of a heavy annual snow slide. As constructed, the vertical curve, at the trestle in front of the terminal has a radius of 200 ft., and the rope is carried on this in saddles on cross-ties at 2 ft. apart. This causes great strain on the traction rope and bucket frames. An incline terminal would have obviated this, and much study and experiment was given to it without satisfactory result, the trouble being the difficulty of attaching the loaded bucket to the traction rope on the incline in safety. The second difficulty was that the sudden deflection of the traction rope from the guide wheel to the first carrying roller was such that attaching could only be done at one point, it being impossible to force the bucket by hand in advance of the lug when the traction rope had entered the grip. This would have been avoided by an inclined terminal, but instead a swinging guide wheel was used ahead of the attaching point, so as to make the traction rope level for a short distance, and thus allow of a bucket being detached and pushed aside. Much difficulty was experienced in getting the material for work to the site of the terminal, as the whole face of the mountain was covered with loose slate and shale, and it was impossible to construct a road without great expense. Also, at the foot of the slope there was a chasm, through which flowed a mountain torrent.

A little 8-HP. hoisting engine was carried to the top, by the means of which the cables were pulled up. These were stretched over low temporary supports, and used as temporary tramways, over which the terminal machinery, timber, etc., could be brought to the site. The engine was worked by compressed air from a neighboring mine. In addition to the physical difficulties, snow lasted until July, and there was almost incessant rain. On heavily loaded lines trouble frequently arises from the severe strains on the bucket frames while passing over intervening summits. This can be partly remedied by frequent supports so placed as to form a vertical curve. Heavy wear is also induced in stationary cables, at such points, so that it is frequently necessary to construct a continuous trestle carrying a solid rail, instead of the standing rope.

Intervening hollows of considerable width are also very troublesome. Ropes must be supported at either end, so as to avoid sharp angles, and in long spans the standing rope should be as nearly as possible independent of the rest of the line. Tension stations may be introduced at such points with advantage, and larger ropes used than for the rest of the line. Long spans properly adjusted are considered a positive advantage to tramway lines, first, on account of their more regular grade, and, second, because points of supports are also points of danger, due to misplaced saddles, etc.

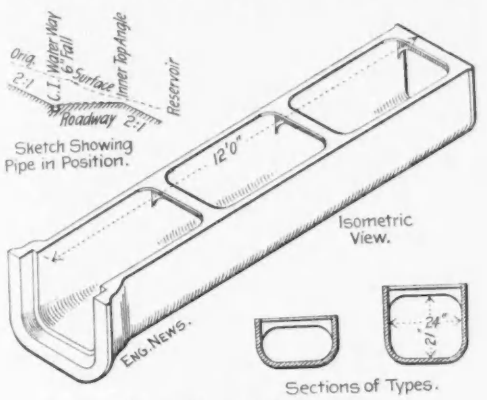
The author has never known an accident to occur on a clear span, except through failure of the grip. The wearing points on carrying cables are only at the supports, hence, a reduction in their number is beneficial. Another advantage is that there are fewer points to be inspected and kept in repair. In designing these long spans they must be carefully arranged, so as to avoid undue wear, and very good results have been obtained by attaching two caps instead of one to the tops of the towers and setting the saddles in such a way as to support an arc some 40 ins. in length. With a radius of 5 ft., this makes a good support for spans up to 1,500 ft. in length.

In the case of the Bunker Hill and Sullivan line, much trouble was experienced until the short spans were removed and the rope carried in one span at a higher elevation for a distance of 1,180 ft. The good effect of this was shown when a runaway took place by the breakage of the guide shaft and not a single bucket was dropped. The buckets on this line were 5 cu. ft. in capacity, and have for a year and a half carried easily 50 tons per hour, or an average of 450 tons for ten hours' work, at the cost of 16 cts. per ton, notwithstanding the high rates of wages paid. This does not include the return transportation of supplies, timber, etc., which frequently amounts to 30 or 40 tons in a day.

*Abstract (from the Society's bulletin) of a paper to be read at the convention of the American Society of Civil Engineers, at Niagara Falls.

A CAST IRON DRAIN.

The accompanying cut, reproduced from a blueprint sent us by Mr. J. K. Lloyd, of Syracuse, N. Y., represents a design for a cast iron waterway to drain a slope above a roadway instead of



Open Drain of Cast Iron.

digging and paving a ditch. The drain is to be cast to suit the grade, the roadway being level. Mr. Lloyd advocates this plan to save unnecessary excavating and washing of material from the sidehill.

IRRIGATION NEEDS IN IDAHO.

At the National Irrigation Congress held in Los Angeles last fall arrangements were made for the appointment of commissions of five members in each of the states and territories where irrigation is practiced. It was proposed that these commissions should study the needs, each of its own state or territory, and collect information bearing on the subject of irrigation, after which an attempt might be made to formulate a general policy to be urged upon Congress and upon the several states for adoption. Mr. F. J. Mills, of Pocatello, Ida., recently delivered an address before the Idaho commission, of which he is secretary, from which the following has been taken:

Idaho is favored with a water supply equalled perhaps by no state in the arid belt, and it is also especially rich in unoccupied lands. To bring together the water and land to the best advantage, proper national and state legislation are necessary. The general government alone is capable of putting water on the public lands under such conditions as will best promote the prosperity of the land owner. If Congress sees fit it should first make small appropriations for disinterested professional reports on the irrigation of the arid lands owned by the general government, after which money could be appropriated for carrying out national irrigation works.

As to state legislation, bearing in mind that the principle underlying it should be the greatest good to the greatest number, individual water consumers should have special care, but no injustice should be done to the owners of water. Provision should be made for an official state record of water rights, and a state commission should be appointed to adjudicate claims. The ownership of land should carry with it the right to use the water necessary for its irrigation, which can only be accomplished by common public ownership of water.

The Wright irrigation district law is applicable only to the development of water for land under private ownership, and therefore could not be adopted in Idaho, where so much of the land needing water is owned by the general government.

The Idaho commission has undertaken the collection of information regarding the water supply of the State available for irrigation, the areas needing water, the consensus of opinion in the State as to changes in the local irrigation laws and other matters bearing upon the general subject.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

BALTIMORE & DRUM POINT.—It is expected that work will soon be resumed in earnest upon this road. Since last December only a small force has been employed, but it is now stated that tracklaying will be commenced within 10 days, and the line be completed from Millersville to Drum Point Harbor within 90 working days. Van Aken & Hayes, Warder Bldg., Washington, are the contractors.

ELKHART & WESTERN.—The stockholders have voted to issue $100,000 in bonds to complete the road from Mishawaka, Ind., to South Bend. Gen. Man., E. C. Bickel, Elkhart, Ind.

ROME, WATERTOWN & OGDENSBURG.—Press reports state that plans are being considered for a branch from Wilson, N. Y., to Wilson Harbor, two miles.

WOOD & CHILDS.—It is stated that Wood & Childs, Cammal, Pa., are building a private railway 10 miles in length.

Projects and Surveys.

BINGHAMTON, PENNSYLVANIA & SOUTHERN.—Incorporated in Pennsylvania to build a steam railway from the terminus of the Binghamton & State Line R. R., to Wyalusing, Pa., 32 miles; capital stock, $800,000; Pres., Edmund O'Connor, Binghamton, N. Y.; W. H. Jessup and Horace Hand, Scranton, Pa., are directors.

MARYLAND & COLUMBIA.—Subscription books were opened at Laurel, Md., May 31, and 7,500 shares subscribed at $50 a share. The company has authority to build a steam or electric railway through the counties of Frederick, Carroll, Montgomery, Howard, Anne Arundel, Baltimore, Hartford and Cecil, and it is reported that the projectors of the boulevard and electric railway between Washington and Baltimore will build the road under the charter granted to this company, and will extend the road from Baltimore to the Pennsylvania state line.

MOHNSVILLE & ADAMSTOWN.—Incorporated to build a steam railway between Mohnsville and Adamstown, Pa.; capital stock, $75,000; Pres., L. T. Custer, Allentown, Pa.

PORT HURON & LEXINGTON.—Incorporated to build a railway between Port Huron and Lexington, Mich.; capital stock, $200,000; E. H. Brennan, T. W. Bainbridge, Toledo, O.; George Shaffer, C. W. Harrah, W. C. Maybury, E. T. Hance, Detroit; Col. William Nichols, New York.

Southern—Existing Roads.

ATLANTIC COAST LINE.—The contract for grading, masonry and trestle work, for the six miles of road at Petersburg, Va., recently noted under Petersburg, has been awarded to Lane Bros., Charlottesville, Va. The work will include a bridge over the Appomattox River. ——The Baltimore "Sun" states as follows: The Atlantic Coast Line system and the Louisville & Nashville are jointly making a survey for a new road from Ashley Junction, S. C., to a connection with the Georgia R. R., at or near Augusta. The Atlantic Coast Line now has a route from Ashley Junction into Charleston, connecting with the terminals in Charleston which were recently purchased in the interest of the Louisville & Nashville, and which formerly belonged to the South Carolina R. R. The Louisville & Nashville is half owner of the lease of the Georgia road from Augusta to Atlanta, with which the new road will connect. The other half of the lease is owned by the Central R. R. of Georgia. The Atlantic Coast Line will make its connection with the projected road at or near Barnwell Court House. The construction of this road will give the Louisville & Nashville Railroad a terminus on the Atlantic ocean at Charleston. The jetties have already secured 22 ft. of water at low tide, and it is said that this will be increased to 25 ft. within a year, giving Charleston excellent shipping facilities.

AUGUSTA SOUTHERN.—The directors are reported to have voted to broaden the gage of this railway, 80 miles in length, and it is stated that the work will be commenced at once; estimated cost, $225,000. Gen. Man., William B. Thomas, Augusta, Ga.

CHESAPEAKE & OHIO.—Press reports from Huntington, W. Va., state that this company is planning to construct a railway paralleling the Norfolk & Western through southern West Virginia to tap coal fields and timber lands. It is stated that this company has purchased over 50,000 acres of land in Raleigh county alone, and that the project includes the largest development enterprise set on foot in years. Certain officials of the company, however, are quoted as denying the report.

Projects and Surveys.

HINTON & NEW RIVER.—It is reported that surveys have been made for this railway from Hinton, W. Va., on the Chesapeake & Ohio, along New River 20 miles to a connection with the Norfolk & Western.

KENTUCKY.—Press reports from Ashland, Ky., state that E. T. Merritt, Duluth, Minn.; A. E. Davis, Johnson City, Tenn.; Col. C. K. Lawrence, West Superior, Wis., under the guidance of John C. C. Mayo, of Paintsville, Ky., are now making a thorough detour of the coal territory of the Upper Big Sandy Valley and particularly Johnston and Pike counties. These gentlemen represent the syndicate which proposes to build a railway from White House to Elkhorn, beyond Pikeville, Ky., and for 60 miles of which contracts are said to have been let to Wolfe & King, Duluth, Minn. This road is to follow very closely the proposed route of the defunct Three C's road, and will penetrate one of the richest coal territories in the state.

Northwest—Existing Roads.

WISCONSIN & MICHIGAN.—It is stated that this road will be extended to Pestigo, Wis., at once.

Projects and Surveys.

BIRD & WELLS LUMBER CO.—Press reports state that this company contemplates building a railway to Cedarville, Wis., eight miles north of Big Wausaukee, where it has extensive timber lands.

DULUTH, SPRINGFIELD & GULF.—Incorporated at Oskaloosa, Ia., May 29, with a capital stock of $1,000,000.

FORT HARRISON.—Bids are asked until June 14 for constructing 5.9 miles of railway at Fort Harrison, Capt. Geo. S. Hoyt, Asst. Q. M., U. S. A., Helena, Mont.

Southwest—Existing Roads.

GREENFIELD & NORTHERN.—Press reports state that this road will probably be extended to connect with the Kansas City, Osceola & Southern.

NORTH GALVESTON, HOUSTON & KANSAS CITY.—Surveys are being made for an extension to Clear Creek, Tex., six miles from the present terminus, and it is reported that the construction will soon be commenced.

Projects and Surveys.

BOONVILLE & GLASGOW.—Incorporated at Glasgow, Mo., May 22, with a capital stock of $250,000.

DONALDSONVILLE & BURNSIDE.—S. H. Lea, Ch. Engr., Burnside, La., writes us as follows: The line is now being located for the Donaldsonville & Burnside R. R., which will extend from Burnside, a station on the Yazoo & Mississippi Valley R. R. to Darrowville, a distance of 4.8 miles. Darrowville is on the Mississippi River, opposite Donaldsonville, La. Communication will be had between these two places by steam ferry boat, for which plans are now being prepared. Bids will be received and construction begun on the railway as soon as the location is finished. The line is to be completed by Oct. 1. Pres., H. C. Brand.

Rocky Mt. and Pacific—Existing Roads.

PORTLAND, VANCOUVER & YAKIMA.—Press reports state as follows concerning this road, recently noted: The road will be built from Portland, Ore., to North Yakima, through a rich agricultural and mineral country. The distance is 150 miles, shortening the present route 158 miles. From Yakima the road will be continued to Spokane and will shorten the distance by way of either the Northern Pacific or Union Pacific by 300 miles. Only names of local capitalists appear among the incorporators, but it is supposed the road will be constructed in the interest of the Great Northern or some other transcontinental line which will soon reach Spokane. Twelve miles of the road are already built from Vancouver. The construction will be continued this summer.

Projects and Surveys.

COLORADO EASTERN.—Articles of incorporation of this railway company, with Bernard J. Burk, New York; Henry T. Rogers, Lucien M. Cuthbert, Eldredge H. Sabin, Jesse P. Sherman and Charles B. Rhodes, of Denver, as incorporators, were filed at Hugo, Colo., May 23. Press reports state that a railway from Scranton, Colo., through Arapahoe, Elbert, Lincoln and Kit Carson counties to a point on the state line at or near where the south fork of the Republican River crosses the state line is proposed.

Foreign.

MEXICO.—A press report states as follows: All arrangements have been made for the building of a branch railway from Linares, Mex., to the San Jose mining district, where copper and gold mines are situated. The road will be about 65 miles long, and will connect with the Monterey & Mexican Gulf at Linares, where a large copper smelter is to be erected to treat the ores from the mines.

MEXICO, CUERNAVACA & PACIFIC.—It is stated that Col. J. H. Hampson, Kansas City, has gone to Cuernavaca, Mex., to arrange for the pushing of work on this partially built railway.

STREET AND ELECTRIC RAILWAYS.

JAMAICA, N. Y.—The highway commissioners have granted a franchise to the Long Island Electric Ry. Co. to lay tracks on New York Ave. and Rockaway Road.

NYACK, N. Y.—C. E. Lambert, Gen. Passenger Agt. West Shore R. R., is interested in a proposed electric railway from this place to West Nyack.

RICHFIELD SPRINGS, N. Y.—It is reported that a company has been formed to build an electric railway from this place to Oneonta, a distance of 34 miles; estimated cost, $7,000 per mile.

WHITE PLAINS, N. Y.—The Electric Railway Co. recently formed is reported as soon to elect officers and begin the work of construction. E. C. Sniffen is interested.

PHILADELPHIA, PA.—The Market St., Frankford & Richmond St. Ry. Co. has been incorporated to construct an elevated road or electric railway over the route proposed by the Market St., Richmond & Frankford Elevated Electric Ry. Co., 30 miles in length; capital stock, $180,000; Pres., W. N. Boyer, 1213 Filbert St.

PITTSBURG, PA.—The Beltzhoover & Armanda Ave. St. Ry. Co. has been incorporated, with a capital stock of $9,000; Pres., W. H. Wenrick; directors, J. M. Bailey, Allegheny; R. A. Carter, A. M. Neeper.

BALTIMORE, MD.—A press report states as follows: James G. Floyd, Agent of the Barrows electric street car system, has made a proposition to the Randallstown, Harrisonville & Granite Rapid Transit Co. to build and equip its road with the Barrows system. It was proposed to furnish the power and to operate the road for one year in consideration of the company raising $10,000 and allowing the builders 20% of the receipts of the first year. It is said that the cost of building the road will be from $12,000 to $15,000, and it is thought that the proposition will be favorably acted upon. The Barrows system is the invention of C. H. Barrows, Willimantic, Conn. Only one rail is used, and that will bear the weight of the car and carry the electric current. On both sides of this rail a kind of wooden trestle work is constructed, over the surface of which the side wheels of the car will pass. The weight of the car, however, will be upon the center rail. Over this rail a two-flanged wheel, from under the middle of the car, will pass. The rail is grooved, and the center wheel so formed as to grip it in such a manner as to hold the car in position. The outside wheels, which pass over the trestle work, are provided for emergencies only. The cars can be operated both by the storage and the trolley systems.

BOONSBORO, MD.—An election will be held June 8 to vote on subscribing $15,000 to the capital stock of an electric railway company for a road between this place and Keedysville.

WASHINGTON, D. C.—A franchise has been asked by the Capital Ry. Co.; directors, J. B. Stetson, Augustus Burgdorf, C. F. Norment, H. W. Sims and others.

ROCKLEDGE, FLA.—The Rockledge Ry. & Improvement Co. has been incorporated, with a capital stock of $10,000.

ST. AUGUSTINE, FLA.—Holmes & Jackson are reported as interested in a movement to securing right of way for a proposed electric railway.

OPELIKA, ALA.—It is stated that arrangements have been completed for the construction of the proposed electric railway from this place to Auburn, a distance of seven miles; Pres., M. E. Gray, Columbus, Ga.; Vice-Pres. and Gen. Man., J. L. Cowan; Secy., C. I. Doughtry.

CINCINNATI, O.—The commissioners of Hamilton county have granted a 25-year franchise to the Col-

lege Hill Electric Ry. Co. to construct a single track on North Bend Road.

CENTERBURG, O.—Right of way has been granted to Harry B. Vansickle for an electric railway to Delaware, according to reports.

CLEVELAND, O.—The Cleveland Electric Ry. Co. will soon construct 4½ miles of double track road, according to reports.——The Cuyahoga Suburban Ry. Co. has been incorporated by H. C. Brent, C. C. Thompson, and others; capital stock, $10,000.

MIDDLETOWN, O.—The commissioners of Butler county have granted a 50-year franchise to the Hamilton, Le Sourdsville & Middletown Electric Ry. Co. for a road from this city to Hamilton.

PORT HURON, MICH.—A company has been incorporated, with a capital stock of $200,000, to build an electric railway between this place and Lexington; directors, E. A. Brennan, T. W. Bainbridge, Toledo, O.; W. C. Maybury, C. W. Harrah, and E. T. Hance, Detroit.

DIXON, ILL.—It is stated that a franchise will be granted this week for an electric railway.

KAUKAUNA, WIS.—A franchise is to be granted to an electric railway company for a road between this place and Oshkosh, according to reports.

PORTLAND, ORE.—Press reports state that an electric railway is to be built from this city to Beaverton, a distance of 7½ miles; estimated cost, $200,000. J. B. Jones, Beaverton; H. E. E. Dosch, and F. V. Andrews, Portland, are interested.

HIGHWAYS.

GEORGIA.—The county commissioners at Waycross have ordered the building of two new roads in Ware county.

NEBRASKA.—F. J. Sackett, Clk. Douglas County, writes us that the contract for paving two roads with macadam has been awarded to E. D. Van Court & Co., and one road with Colorado sandstone to Hugh Murphy, both of Omaha. The price to be paid for sandstone is $3.85 per lin. ft., laid upon 5 ins. sand, rolled, with Packing curb. The blocks are 5 × 8 to 12 × 3 to 5 ins.

WASHINGTON.—It is reported that surveys have been made for a plank road from Granite Falls to Everett, Snohomish county, a distance of 13 miles.

CALIFORNIA.—A committee has been appointed at Oakland to have surveys made for the construction of a road to connect Alameda and Contra Costa counties.

BRIDGES AND TUNNELS.

NIAGARA FALLS, N. Y.—Estimates have been received from several bridge companies for an iron bridge over the canal at Second St. It is probable that bids will be asked.

PHILADELPHIA, PA.—Bids are asked until June 8 for the construction of bridges. Jas. H. Windrim, Dir. Dept. Pub Wks.

SELIN'S GROVE, PA.—The commissioners of Snyder county are making preparation to rebuild the four bridges destroyed by high water.

NEW ORLEANS, LA.—The city comptroller has been authorized to advertise 20 days for bids for a new bridge at the halfway house, and for 10 days for an iron bridge at the corner of Esplanade and Broad Sts.

ALLIANCE, O.—The city council has authorized the sale of $9,500 of bonds for a new bridge across the Pittsburg, Fort Wayne & Chicago R. R.

HAMILTON, O.—Bids are asked until June 22 for the abutments for a bridge across Gregory's Creek in Lemon township. Frank X. Duerr, Audr. Butler county.

TOLEDO, O.—The construction of a $200,000 bridge over the Maumee River is being agitated. Albert Neukom is interested.

MARION, IND.—Bids are asked until June 30 for the construction of a wrought iron or steel bridge over the Mississinewa River at Washington St. Geo. A. Osborn, Audr. Grant county.

LANSING, MICH.—It is stated that an election was held June 5 to vote on building a $40,000 bridge. H. D. Bartholomew, Cy. Engr.

MILWAUKEE, WIS.—The contract for an iron bridge across the Kinnickinnic River at Eighth Ave., has been awarded to Thomas R. Bentiy, at $4,597.

ASHLAND, WIS.—A press report states that the Omaha railway company has submitted plans to the board of public works for the construction of a $10,000 steel bridge over Vaughn Ave. with stone abutments, which will be the means of settling the suit now pending between the city and the company, and that the three other roads will probably also construct steel bridges.

DUBUQUE, IA.—The Dubuque & Wisconsin Bridge Co. has been organized to construct a bridge over the Mississippi River at this city; capital stock, $100,000.

FORT DODGE, IA.—Bids are asked until June 13 for an iron bridge across the Des Moines River between Yell and Marion townships. T. A. Cunningham, Audr. Webster county.

SIOUX CITY, IA.—It is stated that an election will soon be held to decide whether a tax amounting to $400,000 will be voted to help build a $1,200,000 independent railway and wagon bridge.

HASTINGS, MINN.—Bids are asked until July 2 for the construction of a highway bridge across the Mississippi River, bidders to furnish plans, as stated in our advertising columns; also until June 25 for the purchase of $40,000 of 30-year 5% bridge bonds. Irving Todd, Jr., Cy. Clk.

CALDWELL, TEX.—Bids are asked until June 20 for the construction of a 40 to 50-ft. iron bridge over Second Creek. Address T. M. Hunt.

DALLAS, TEX.—Bids are asked by the commissioner's court of Dallas county until June 9 for a 30-ft. wooden draw or turntable bridge across Trinity River.

ASTORIA, ORE.—It is reported that bids are being received for the construction of a bridge across Young's Bay.

WATER-WORKS.

GORHAM, ME.—The Gorham Water Co. is investigating the advisability of putting in works.

MECHANIC FALLS, ME.—A. J. Weston, Chn. Com., writes us that surveys for works are being made by E. H. Gowing, 95 Milk St., Boston.

BARTON LANDING, VT.—H. S. Webster, Clk., writes us that the village is building works.

LUDLOW, VT.—Frank A. Walker, Clk., writes us that the citizens have voted to put in works estimated to cost $20,500. Work will probably be done by day labor. Engr., Joel Foster, Montpelier.

MANCHESTER CENTER, VT.—Action has been taken to build works, according to reports.

ARLINGTON, MASS.—Frank L. Fuller, Engr., has prepared plans for a high-service system in connection with the works, and at a town meeting May 28 it was voted to issue $92,000 in bonds to carry out the plans. Water is to be taken from driven wells and pumped to a 40 × 60 ft. stand-pipe.

BARRE, MASS.—C. C. Cook, Town Clk., writes us that a company has been incorporated to put in works; supply one mile from village.

BLACKSTONE, MASS.—C. R. Day writes us that a charter has just been granted to the Blackstone Water Co. to put in works, but that no further steps have yet been taken.

BROOKLINE, MASS.—Zeph. R. Forbes, Water Registrar, writes us that $30,000 has been appropriated for extensions. One mile of 20 and 16-in. pipe will be laid, and about 150 2½-in. driven wells will be connected with this, work to be done by town. Engr., F. F. Forbes.

FOXBORO, MASS.—Bids are asked by the commissioners for laying about three miles of pipe. Geo. F. Williams, Clk.

LANCASTER, MASS.—W. H. Blood, Supt. of Sts., writes us that the town has voted to appropriate $6,000 for extensions. The work will be done by day labor. Engr., Harold Parker, South Lancaster, Mass.

LEOMINSTER, MASS.—C. A. Joslin, Town Clk., writes us that contracts for materials for the proposed extensions have all been awarded and that the work will be done by day labor.

MONSON, MASS.—At a town meeting, May 31, it was voted to issue bonds for $65,000 to construct works. A. D. Norcross, E. F. Morris and R. M. Reynolds were appointed commissioners.

PROVIDENCE, R. I.—The common council on June 4 concurred in the appropriation of $150,000 for a Morison-Jewel mechanical filtration plant.

AMITYVILLE, N. Y.—The water company offers to extend its mains and furnish 45 hydrants for five years at an annual rental of $1,000. The question will be voted upon June 15.

BAY SHORE, N. Y.—Bids are asked for constructing works, according to reports.

CARTHAGE, N. Y.—The village of West Carthage is considering the advisability of putting in works; estimated cost, $15,000.

CHARLOTTE, N. Y.—D. R. Warner, Clk., writes us that a survey is being made for putting in a sewer, but that no steps have been taken for water-works.

CORNING, N. Y.—The council is discussing an appropriation of $100,000 for extending the works.

COXSACKIE, N. Y.—It is stated that an election was held June 5 to vote on the question of putting in works.

DAVENPORT, N. Y.—H. S. Wickham, Pres. Davenport Water Co., writes us that works are to be built; contracts not yet awarded; supply from springs; population, 500.

EARLVILLE, N. Y.—An election will be held June 9 to vote on the question of works, for which surveys have been made.

FORESTVILLE, N. Y.—W. H. Parsons, Secy., writes us that the investigation for a supply from springs for proposed works has been postponed until the dry season; population, 800.

FORT PLAIN, N. Y.—It is reported that the village will purchase the works or construct new works.

FREDONIA, N. Y.—The question of a 75,000,000-gallon storage reservoir is being discussed.

FULTON, N. Y.—W. P. Hillick, Clk., writes us that the Fulton Water Co. has been authorized to make certain extensions. The work will probably be done by the company.

GLENS FALLS, N. Y.—The village has sold $80,000 of 4% water bonds for $82,427.

LANCASTER, N. Y.—Bids are asked until July 1 for works, as stated in our advertising columns. John Leininger, Village Clk.

MONROE, N. Y.—Gilbert Carpenter writes us that the question of works is being agitated, and that an election will probably be held in six weeks.

NEW HARTFORD, N. Y.—The water company has secured the right of way for works; supply from springs; work on reservoir will be commenced at once.

PENN YAN, N. Y.—Bids are asked until June 14 for constructing works (extension of time from June 6). W. N. Wise, Secy. Comrs.

PORT JERVIS, N. Y.—The Port Jervis Water Co. held a meeting June 5 to vote on increasing its capital stock $10,000.

ROCHESTER, N. Y.—Bids are asked until June 15 for 5,952 tons of 36 to 6-in. pipe, as stated in our advertising columns. Thos. J. Neville, Clk.

SYLVAN BEACH, N. Y.—J. S. Cleveland, Palmyra, and others, have contracted to put in works to be completed by July 4; supply from springs.

TROY, N. Y.—Specifications have been prepared for two new 175-HP. boilers, for which it is stated that bids will soon be received.

CAMDEN, N. J.—M. J. Fanning, Minneapolis, has reported in favor of a supply from the Delaware River and the building of a settling basin at Fisher's Point, and a new pumping station.

EGG HARBOR, N. J.—V. P. Hofmann, Cy. Clk., writes us that an election will probably be held to vote on the question of works; population, 1,500.

FREEHOLD, N. J.—N. J. Conover, Engr., writes us that the contract for the proposed turbine wheel and power pump has been awarded to T. C. Alcott & Son, Mount Holly, at $1,424 for an Alcott wheel and a Deane pump.

MILLVILLE, N. J.—L. H. Hogate, Cy. Recdr., writes us that the committee is investigating the question of purchasing the works.

NEWTON, N. J.—An election will be held June 26 to vote on the question of town ownership of works.

ORANGE, N. J.—The committee has been authorized to ask for bids for 300 tons of 3 to 6-in. pipe.

PEMBERTON, N. J.—It is stated that a company is being organized to put in works.

BLOOMSBURG, PA.—The Bloomsburg Water Co. is considering the question of increasing its capital stock form $90,000 to $180,000.

CONFLUENCE, PA.—Another effort is reported as being made to secure works.

EDDYSTONE, PA.—The question of works is being investigated. Address Sam'l Chandley.

GREAT BEND, PA.—W. T. Estabrook, Secy., writes us that 6 and 4-in. mains are now being laid; gravity supply from a lake 2½ miles distant.

MEADVILLE, PA.—The council is taking steps to secure the construction of new works; estimated cost, about $75,000.

NORTHUMBERLAND, PA.—J. G. Diffenbach, Town Clerk, writes us that the Northumberland Water Co. states that a plant will be put in this season; supply from springs 3½ miles distant; population, 2,800.

READING, PA.—The contract for the new 10,000,000-gallon pumping engine has been awarded to Henry R. Worthington, New York. Bids were published May 10. I. C. Fetter, Secy. Comrs.

SOMERSET, PA.—The contract for works has been awarded to Malone Bros., of Blair county, according to reports.

WERNERSVILLE, PA.—It is stated that a company is being organized to secure a supply from South Mountain Springs.

BRUNSWICK, MD.—The proposed issue of $40,000 in bonds for putting in works was defeated May 28.

FREDERICK, MD.—The aldermen have authorized an issue of $35,000 of 30-year 4% bonds for the new reservoir.

SNOW HILL, MD.—We are informed that no action has yet been taken concerning the proposed works.

BIG STONE GAP, VA.—The Glamorgan Co., of Lynchburg, is reported to have purchased the works for $17,500.

GRAFTON, W. VA.—Wilkins & Davison, Pittsburg, Pa., have been engaged as engineers of the proposed works; estimated cost, about $50,000

MOUNDSVILLE, W. VA.—The franchise recently granted has been secured by Col. Ben Wilson, who has contracted to begin the construction of works within 60 days, according to reports; supply from artesian wells.

RONCEVERTE, W. VA.—The election resulted, 157 to 21, in favor of works, which will probably be put in at once.

INTERLACHEN, FLA.—H. G. Hastings is reported as interested in proposed works.

QUINCY, FLA.—H. J. Davis writes us that the Quincy Water Co. is planning to put in works to cost about $10,000; supply from artesian wells.

STARKE, FLA.—W. N. Meacham writes us that a committee has been appointed to investigate the question of works, which will probably be put in soon.

STEVENSON, ALA.—Steps are reported as being taken to secure a gravity supply.

NEW ORLEANS, LA.—The contract for works at the Marine Hospital has been awarded to Manion & Co., New Orleans, at $2,238.

THIBODEAUX, LA.—There is talk of works, according to reports.

HUMBOLDT, TENN.—J. C. Crewe, Mayor, writes us that Engineer Lancaster, of Jackson, Tenn., is preparing plans and specifications for works, after which the contract for everything except the stand-pipe will be let to the lowest bidder.

NEWPORT, TENN.—It is reported that a supply will be secured for fire protection.

DANVILLE, KY.—E. W. Smith, Rest. Engr., writes us that the city has sold the $70,000 of water-works bonds to the Kansas City Trust Co., at a premium of 1½%.

SHELBYVILLE, KY.—L. Channing, Pres., Shelbyville Water & Light Co., writes us that the validity of the contract with the city is now being tested, after which contracts will probably be awarded for constructing works.

ALLIANCE, O.—Press reports state that the Pennsylvania Co. is arranging to put in private works. The company now pays $2,500 a year for its supply in this city.

ASHLAND, O.—W. S. Coon, Toledo, O., has reported that works, including 90 fire hydrants, 9 miles of mains, two pumping engines, stand-pipe, etc., can be put in for $38,000.

ATTICA, O.—The question of works continues to be investigated.

BELLEVUE, O.—W. H. Derrick, Cy. Clk., writes us that the city is receiving bids for a new stand-pipe and extensions, for which $12,000 in bonds have been issued.

DAYTON, O.—Bids are asked until June 18 for laying service pipes. C. A. Herbig, Cy. Comptroller.

GALLIPOLIS, O.—Bids are asked until June 15 for constructing works; supply from Ohio River; estimated cost, $85,000. Des. Engr., Samuel M. Gray, Providence, R. I.

LOUISVILLE, O.—The question of works will be voted upon June 21.

MADISONVILLE, O.—Bids are asked until June 25 for the purchase of $10,000 of 5% electric light and water-works bonds. Bennett Carter, Village Clk.

NAPOLEON, O.—A contract for works will probably be awarded next month. Engr., J. B. Strawn, Salem, O.

PIEDMONT, O.—We are informed that works are about completed; population, 200.

SANDUSKY, O.—Bids are asked until June 15 for about 40,000 ft. of 12 to 4-in. pipe, and 125 6 and 8-in. valves, and 60 hydrants, as stated in our advertising columns. Chas. A. Judson, Supt.

ST. BERNARD, O.—Bids are asked until July 7 for constructing works, as stated in our advertising columns. Engr., Geo. Hornung, Cincinnati. Herman J. Witte, Pres. Trustees.

AURORA, IND.—The city clerk writes us that the question of works will probably be settled by the council within a few days.

BORDEN, IND.—Dr. J. M. Wheate writes us that the proposed works will include a reservoir, about

2,000 ft. of 4-in. main and 7 or 8 fire hydrants. Prof. W. W. Borden has offered to take half the stock if a company is organized. Engr., W. N. Morrill, New Albany.

DUNKIRK, IND.—The council is reported to have voted for works.

HAGERSTOWN, IND.—J. M. Hartley, Town Clerk, writes us that there is no prospect of works at present.

HUNTINGTON, IND.—Bids are asked until June 28 for lowering pumping machinery, etc., 10 ft.; also for resetting boilers, etc. Sam'l Buchanan, Clk.

KNIGHTSTOWN, IND.—The council has sold $20,000 of water bonds for $21,756.

NORTH MANCHESTER, IND.—The works have been completed by W. S. Coon & Sons, Toledo, O., and have been tested and accepted. About five miles of pipe were laid; pressure, 150 lbs. per sq. in.

CHESANING, MICH.—G. L. Chapman writes us that the council was expected to take action on issuing bonds for works at its meeting June 6.

GRAND BLANC, MICH.—John H. Cartwright writes us that no steps have yet been taken for works.

LAKE ANN, MICH.—Bids are being received for a suction pump, reservoir, 2,200 ft. of 4-in. pipe, 1,400 ft. of 6-in. pipe and 6 hydrants; water supply from wells; estimated cost of works, $3,500. C. H. Thomas.

McBAIN, MICH.—The citizens have voted, 77 to 3, to issue $4,500 in bonds for works.

CHICAGO, ILL.—Bids are asked until June 13 for laying mains in 27 streets. H. J. Jones, Comr. Pub. Wks.

DOWNER'S GROVE, ILL.—Bids for a brick pumping station, pumping engines, boilers, etc., for the new works will be awarded June 11, as noted in our advertising columns last week. Consult. Engr., W. S. Shields, 1,608, Title and Trust Bldg., Chicago. Guy L. Bush, Chn.

DUQUOIN, ILL.—The council is reported as considering the purchase of land two miles from the village as a site for works.

MOLINE, ILL.—The council has voted to issue bonds for extensions, but we are informed that the work has not been definitely decided upon. T. D. Wheelock, Ch. Engr.

WHEATON, ILL.—W. S. Shields, Title and Trust Bldg., Chicago, has been engaged as consulting engineer for the new works.

DODGEVILLE, WIS.—Plans and specifications are being prepared by Mr. Hackett, of Fairbanks, Morse & Co. J. C. Meuer, Cy. Clk.

EDGERTON, WIS.—Bids are asked for a franchise for works consisting of 3½ miles of mains, 35 hydrants, etc. Henry Johnson, Cy. Clk.

KENOSHA, WIS.—The Kenosha Water Co. has been incorporated by E. S. Hazleton, Lewis Bain and D. C. Lloyd; capital stock, $3,000.

ALTA, IA.—The citizens have voted to issue $5,000 in bonds for works.

DOON, IA.—The construction of works is expected to be commenced at once, bonds having been voted.

JEFFERSON, IA.—S. C. Lee, of the committee on works, writes us that the U. S. Wind Engine & Pump Co., Batavia, Ill., is preparing plans for works to be owned by the city; including 100,000-gallon tank on steel substructure, two miles of pipe, 16 hydrants; well cost $6,000; estimated cost of works, $20,000. Bids for construction will be received within a few days.

DULUTH, MINN.—A court decision has declared against the validity of the issue of the $800,000 of bonds authorized in January for constructing new works, on the ground that the special election was illegally held.

MINNEAPOLIS, MINN.—Thos. Lowry is reported to have offered to donate 15 acres of land at Columbia Heights, one mile from the city limits, for a reservoir and filtering system.

SANBORN, MINN.—The council is reported as considering the question of works.

CHERRYVALE, KAN.—J. M. Courtney, Supt., writes us concerning the recently incorporated Cherryvale Water Co. That no extensions are proposed for this year and that the works will be operated as heretofore.

BERTRAND, NEB.—The trustees are reported as talking of borrowing money for works., the people having recently voted against issuing bonds.

FULLERTON, NEB.—Bds are asked until June 23 for constructing works estimated to cost $13,000. Engr., G. H. Ellsworth; S. H. Penny, Mayor.

PENDER, NEB.—Bids are asked until June 16 for constructing works, including pumping engine and stand-pipe. Engr., L. F. Wakefield, Sioux City, Ia. Geo. F. Chittenden, Village Clk.——Bids are asked until June 9 for the purchase of $16,000 of 20-year 6% water bonds.

WILBER, NEB.—The citizens have voted to issue $17,000 in bonds for works.

CENTREVILLE, S. DAK.—Bids are asked until July 2 for constructing works. Engr., A. A. Richardson, Lincoln, Neb.

FLANDREAU, S. DAK.—It is stated that $10,000 has been raised for works, for which plans will be prepared at once.

CAPE GIRARDEAU, MO.—The city has engaged Isaac A. Smith, St. Louis, as consulting engineer for proposed works. It is stated that the contract for constructing the works has been awarded to the Gannon Plumbing Co.

ST. LOUIS, MO.—The following bids were received for the proposed work at high-service station No. 3 at Baden: W. S. Carter & Co., $135,361; H. Rueckling & Co., $145,575; Penny, McCabe & Meyers, $136,918; Wm. Benn and John Dean, $111,566; T. J. Prosser, $124,130; Thompson & Gray, $107,470; Gillick Bros., $176,677; G. T. Nellis & Co., $120,885; August and William Heman, $121,490; James Black Masonry and Construction Co., $146,517; Abbot-Gambell Construction Co., $142,569; Hill-O'Meara Construction Co., $125,650; McCully Stone Mason Co., $127,367; Fruin-Bambrick Construction Co., $129,397; James Stewart & Co., $158,112; R. S. Colnon, $148,725; T. H. O'Neil, $160,050; Claus Vieths, $130,450.

MONTICELLO, ARK.—The local press thinks the city should have works and an electric light plant.

DALLAS, TEX.—The committee on building a dam on the Elm Fork of Trinity River has reported against the proposed dam and in favor of a dam at the present pumping station and that bids be asked for plans, etc., for a filtering plant.

FORT WORTH, TEX.—The committee has been authorized to investigate the question of increasing the supply. Address the mayor.

HEMPSTEAD, TEX.—The Hempstead Water-Works Co. has been incorporated by A. C. Tompkins, A. G. Lipscomb and B. Schwartz; capital stock, $20,000.

KARNES CITY, TEX.—It is stated that materials have been purchased for works.

MARBLE FALLS, TEX.—It is stated that works will be put in at once.

SAN ANTONIO, TEX.—Under the new contract the water company is to lay 24,000 ft. of extensions each year, according to press reports.

MANITOU, COLO.—The city has sold $14,000 of water bonds.

TOMAH, WASH.—A committee is investigating the question of works. F. J. Skinner, Cy. Clk.

OAKLAND, CAL.—The Oakland Water Co. has contracted with the Edward P. Allis Co., Milwaukee, for a 15,000,000-gallon pumping plant.

SAN FRANCISCO, CAL.—J. W. S. Patterson, Deputy Clk. Bd., writes us that the question of a supply for this city and county has been postponed until July 24. The bids received May 22 were as follows: A. W. Von Schmidt, 30,000,000 gallons daily, from Lake Tahoe, $13,000,000; E. K. Alsip, 30,000,000 gallons daily, capable of being increased to 100,000,000 gallons, from North Fork of American River, as follows—30,000,000 gallons, $11,875,000; 40,000,000, $12,716,500; 50,000,000, $13,325,000; 60,000,000, $14,200,000; Geo. M. Harris, right, title and interest in the River Tuolumne from Grand Canon to its outlet in the bay, $200,000; Arthur Young, Pres. El Dorado Water & Deep Gravel Mining Co., 35,000,000 gallons per day, $900,000; M. C. Taylor, Grass Valley, source of supply, melting snows in the Sierra Nevada Mountains, 23,000,000 to 40,000,000 gallons delivered at different elevations, $8,600,000; W. V. Clark, supply from the Sierras, $10,000,000.——The Consumers' Water Co. has been incorporated, with a capital stock of $1,000,000.

YARMOUTH, N. S.—The contract for constructing the proposed reservoir has been awarded to Surrette & Co., at $14,461.

BROCKVILLE, ONT.—B. J. Saunders, Engr., writes us that it is proposed to add a 2,500,000 or 3,000,000-gallon pumping engine.

SUDBURY, ONT.—It is stated that a vote will soon be taken on the question of issuing $30,000 in bonds for works.

ARTESIAN WELLS.

VELASCO, TEX.—J. R. Marmion is reported as preparing to bore one or two artesian wells on the Tinsley League between this place and Angleton.

IRRIGATION.

RAPID CITY, S. DAK.—The Dakota Water Power Co. is having surveys made for several miles of pipe line and for storage reservoirs near this city, according to press reports; estimated cost, $300,000. Jas. Halley and Geo. B. Mansfield are members of a local committee to aid the project.

NEW COMPANIES.—San Saba River Irrigation Co., San Saba, Tex.; $250,000; J. M. Ingle; W. R. Brook, El Paso; J. F. Dickens, Alameda, Cal.——Lupton Bottom Ditch Co., Fort Lupton, Colo.; $8,300; T. E. Wheeler, G. I. Tracy, M. W. Slate.

SEWERS.

LUDLOW, VT. Frank A. Walker, Village Clk., writes us that the village has voted to issue $8,000 of 4% bonds for sewers.

VERGENNES, VT.—J. D. Smith, Clk., writes us that the pipe for the sewer recently noted has been purchased.

ATHOL, MASS.—E. V. Wilson, Chn. Com. on Plans, writes us that bids will soon be received for eight miles of pipe sewers; estimated cost, $40,000. An engineer will be engaged this week to make plans.

MEDFIELD, MASS.—The committee is discussing extending the system. C. A. Hicks, Engr.

WOBURN, MASS.—J. H. Finn, Cy. Clk., writes us that the city has purchased the plans made by M. M. Tidd for a system.

CENTRAL FALLS, R. I.—Bids are asked until June 9 for constructing 3,000 lin. ft. of brick and 3,400 lin. ft. of pipe sewers, as stated in our advertising columns last week. R. S. Dame, Secy. Bd. Comrs.

EAST HARTFORD, CONN.—The city surveyor is making plans for a system.

AUBURN, N. Y.—The council is discussing the construction of sewers in several streets.

BATAVIA, N. Y.—J. W. Holmes, of this place, is making plans for a system. Consult. Engr., Emil Kuichling, Rochester.

FAR ROCKAWAY, N. Y.—The construction of a system is being agitated.

GLENS FALLS, N. Y.—An election was held June 5 to vote on appropriating $25,000 for completing the system.

ROUND BROOK, N. J.—A meeting will be held June 20 to consider the plans for a system. H. M. Herbert, Borough Engr.

BRIDGETON, N. J.—The question of constructing a system of sewerage continues to be agitated.

ALLEGHENY, PA.—The committee has recommended that sewers be constructed in five streets.

ALTOONA, PA.—Bids are asked until June 9 for constructing sewers in the second district. M. V. Orner, Chn.

ERIE, PA.—The council is discussing the construction of a main sewer in 24th St.; estimated cost, about $40,000.

MEADVILLE, PA.—Bids are asked until June 13 for constructing 3,700 ft. of 34 to 30-in. brick sewer and 7,000 ft. of 24 to 8-in. pipe sewer. W. R. Vance, Cy. Clk.

NORRISTOWN, PA.—A committee is investigating the question of a system. M. D. Patterson, Village Engr.

PHILADELPHIA, PA.—Bids are asked until June 8 for constructing main and branch sewers. Jas. H. Windrim, Dir. Dept. Pub. Wks.——An ordinance has been introduced in the council to appropriate $300,000 for extending the Aramingo Canal sewer.

PITTSBURG, PA.—The council has adopted ordinances for constructing 15 and 18-in. pipe sewers in nine streets. W. C. Gearing, Clk.

HENDERSON, KY.—J. C. Thomasson, Cy. Clk., writes us that Waring, Chapman & Farquhar have completed the survey for a complete system.

AKRON, O.—Bids are asked until June 23 for constructing sewers in two districts. F. C. Wilson, Cy. Clk.

BRIDGEPORT, O.—Bids are asked until June 18 for the purchase of $25,000 of 5% sewer bonds. O. W. Howell, Clk.

CINCINNATI, O.—Bids are asked by the board of administration until June 14 for constructing a sewer in one street, and until June 28 for sewers in four streets.

DAYTON, O.—Bids are asked until June 11 and 18 for constructing house sewer connections. C. A. Herbig, Cy. Comptroller.——The council has adopted ordinances for sewers in two districts.

HAMILTON, O.—Bids are asked until July 3 for the purchase of $60,000 of 4½% sewer bonds. J. J. McMaken, Cy. Clk.——The council has adopted resolutions for constructing sewers in four streets.

SANDUSKY, O.—The council has directed that bids be asked for the construction of a main sewer in Meigs St. A. W. Miller, Cy. Clk.

DETROIT, MICH.—It is reported that W. P. Langley and John Wagner were the lowest bidders for a $50,000 outlet sewer through Owen Park.

DOWAGIAC, MICH.—Hi. Arthur, Cy. Clk., writes us that the city would like an engineer to make estimates for a system.

GREEN BAY, MICH.—Bids are asked until June 15 for constructing a 15-in. pipe sewer in Pleasant St. X. Parmentier, Cy. Clk.

SAGINAW, MICH.—The council has adopted resolutions for constructing 15 and 12-in. pipe sewers in two streets.

CHICAGO, ILL.—Bids are asked until June 13 for building sewers in three streets. H. J. Jones, Comr. Pub. Wks.

FREEPORT, ILL.—Bids are asked until June 15 for constructing about 2,000 lin. ft. of 15 to 12-in. pipe sewer. Geo. H. Tandy, Cy. Clk.

MADISON, WIS.—A committee has been appointed by the council to visit Chicago to investigate the question of Shone ejectors. The estimated cost of the proposed sewage disposal plant is about $40,000.

MUSCATINE, IA.—The council has adopted ordinances for constructing 20 to 8-in. pipe sewers in several streets.

JEFFERSON CITY, MO. E. F. C. Harding, Cy. Engr., writes us that Matt & Roberts, Kansas City, have been awarded the contract for constructing sewers in two districts, at $5,822.

ST. JOSEPH, MO.—Contracts will probably be awarded next month for brick sewers, to cost about $32,000. C. W. Campbell, Cy. Engr.

MINERAL WELLS, TEX.—It is reported that this place is discussing the construction of a system.

DENVER, COLO.—The board of public works has decided to begin work at once on the Delgany St. extension, noted last week. The work will include 14,736 lin. ft. of 92 to 70-in. brick sewer, estimated cost about $318,512, and is to be done by day labor.

SANTA FE, N. MEX.—The committee has been urged to take immediate action and report plans for a sewerage system.

SEATTLE, WASH.—Right of way has been secured for an extension of the Kenny St. sewer.

SACRAMENTO, CAL.—Bids are asked until June 20 for plans for a sewerage system. Premiums of $500 and $200 will be given. O. S. Flint, Cy. Clk.

SAN FRANCISCO, CAL.—The Mission Overflow District Association is discussing the extension of the sewer in 14th St.

HANTSPORT, N. S.—It is reported that Dr. Margeson has made surveys for a system.

WINNIPEG, MAN.—The board of works has recommended that bids be asked for $2,100 worth of sewer pipe and for the construction of a $9,000 sewer.

STREETS.

REVERE, MASS.—Bids are asked until June 12 for building about one mile of street, excavating 20,000 cu. yds., etc. Engr., H. T. Whitman, 85 Devonshire St., Boston. Address W. G. Harris, 116 Tremont St., Boston.

ROCKPORT, MASS.—Bids are asked until June 9 for constructing 1,300 lin. ft. of road. J. L. Woodfall, Secy. Water Comrs.

BRIDGEPORT, CONN.—A committee has been appointed to urge the council to pave with asphalt the streets through which the Traction Co. is to lay tracks. The work will cost about $36,000 and only $12,000 has been voted.

HARTFORD, CONN.—A committee of city officials is investigating pavements in other cities. C. H. Bunce, Cy. Surv.

BROOKLYN, N. Y.—The park commissioner has submitted a plan, prepared by the assistant engineer, for the proposed extension of Eastern Parkway; estimated cost, about $500,000, of which $380,000 is for land.

ITHACA, N. Y.—Bids are asked until June 21 for paving 7,000 sq. yds. with brick; estimated cost, $20,000. H. A. St. John, Supt. Com.

NIAGARA FALLS, N. Y.—The board of public works is discussing the paving of Main St., at an estimated cost of about $94,000.

SCHENECTADY, N. Y.—Bids are asked until June 12

for paving 3,000 sq. yds. with granite. L. B. Sebring, Cy. Engr.

SYRACUSE, N. Y.—The council is discussing the paving of several additional streets with asphalt or brick.

WATERTOWN, N. Y.—The board of public works has recommended that $17,000 be appropriated to pave Public Square with asphalt.

WAVERLY, N. Y.—Bids are asked by the council until June 12 for paving Broad St. with brick.

YONKERS, N. Y.—The commissioner of public works is reported to have submitted plans for a large amount of street work.

BLOOMFIELD, N. J.—The township committee has ordered the macadamizing of eight streets.

NEWARK, N. J.—Bids are asked until June 11 for repaving Broad St. with granite blocks, and for grading Fifteenth Ave. Chas. Marsh, Supt. Pub. Wks.

BELLEVUE, PA.—The contract for paving Sprague Ave. has been awarded to McCready & Rosser, Braddock, at $11,923.

PHILIPSBURG, PA.—Bids are asked for paving 7,500 sq. yds. with brick.

PITTSBURG, PA.—The council has adopted ordinances for improving 10 streets. W. C. Gearing, Clk.

WILLIAMSPORT, PA.—Bids are asked until June 21 for repaving with brick and asphalt about 8,840 sq. yds., as stated in our advertising columns. W. I. Dreisbach, Cy. Clk.

WILMERDING, PA.—The borough has sold $70,000 in bonds for improving the streets.

BRUNSWICK, MD.—The city has voted to issue $10,000 in bonds for street improvements, $2,500 to be issued each year.

MOUNDSVILLE, W. VA.—J. D. Burley, Cy. Clk., writes us that the proposition to issue $20,000 of paving bonds was defeated June 2.

TAVARES, FLA.—This place has voted to issue bonds for $5,000 for street improvements.

MONTGOMERY, ALA.—Bids are asked until June 18 for paving Dexter St. with brick. R. H. Sommerville, Cy. Treas.

NEW ORLEANS, LA.—The council has directed the comptroller to advertise for bids for paving several streets with brick, granite or gravel.

LOUISVILLE, KY.—Bids are asked by the board of public works until June 15 for 22 contracts for street improvements.

AKRON, O.—Bids are asked until June 16 for grading Ruff St. F. C. Wilson, Cy. Clk.

ASHLAND, O.—The paving of two main streets with brick is being discussed.

BOND HILL, O.—Bids are asked until June 11 for improving Forest Ave. W. H. Brickel, Jr., Cy. Clk.

CARDINGTON, O.—It is reported that the citizens have voted to pave the streets.

CINCINNATI, O.—Bids are asked by the board of administration until June 13 for grading and paving Court Alley with brick.—The contract for improving Kenton St. has been awarded to Kirchner & Fo'z at $12,741; the other bids were as follows: T. J. Mulligan, $15,444; J. E. O'Brien, $14,256; M. Peter, $15,763; J. Delaney, $15,173; J. McDermott, $14,923; Van Zandt & Meeds, $16,348; M. Garretson & Co., $15,433; M. C. Hayes, $15,046; M. T. Flynn, $14,501; C. N. Danenhower, $13,696; E. Evans, $14,007; H. Eyerman & Co., $14,127; Henkel & Sullivan, $15,331.

DAYTON, O.—Bids are asked until July 2 for paving about 68,000 sq. yds. with asphalt, granite or stone. C. A. Herb'g, Cy. Comptroller.

NORWOOD, O.—Bids are asked until June 29 for the purchase of $21,606 of street improvement bonds. W. E. Wichgar, Clk.

OAK HARBOR, O.—Bids are asked until June 27 for paving 6,500 sq. yds. with brick on crushed stone foundation. E. A. Smith, Cy. Engr.

SANDUSKY, O.—Bids are asked until June 18 for paving Warren St. with brick. A. W. Miller, Cy. Clk.

LANSING, MICH.—The council has ordered the paving of Capitol Ave. with brick; estimated cost, $9,300.—The paving with brick of other streets is being discussed.

AURORA, ILL.—The council has voted to advertise for bids for paving North Lake St.

CHICAGO, ILL.—The Eureka Paving Co. has been incorporated with a capital stock of $5,000.

CRETE, ILL.—A considerable amount of street improvements will be made this year. Engrs., Alexander, Hill & Enricht, Chamber of Commerce Bldg, Chicago.

FREEPORT, ILL.—Bids are asked until June 15 for paving 22,534 sq. yds. with cedar blocks. G. H. Tandy, Cy. Clk.

PEKIN, ILL.—Bids were opened May 25 for 10,864 sq. yds. of paving with 1 × 4 × 8-in. brick, with 2,374 cu. yds. of excavation. There will be a foundation of 3 ins. of gravel and 2 ins. of sand, the first layer of brick being placed flat and covered with 1 in. of sand and the second layer placed edgeways and the whole covered with ½ in. of screened sand. The total bids were as follows:

Estimated cost	$15,684
Michael, Merrill & Michael, Pekin	13,522
Day & Dougherty, Canton	13,658
Marquardt & Lumpitt, Pekin	14,327
A. Mayfield, Lincoln	14,489
John F. Bretz & Son, Springfield	14,775
Mall & Dean, Aurora	15,046
J. S. Allen, Peoria	15,141
Rockford Construction Co., Rockford	15,151
Cosgrove & McDonald, Chicago	15,335
Henry Dossler, Cedar Rapids, Ia	15,358
Edwards & Welsh, Davenport, Ia	15,477
John Cherry, Jacksonville	15,576
Valentine Jobst, Peoria	15,576
M. J. LaBounty, Chicago	16,346
W. R. Glann Construction Co., Galesburg	15,639
A. E. Lee, Pekin	15,778
Kansas City Construction Co., Kansas City	16,090
Scharman, Stad & Collon, Pekin	16,366
Johnson, Zoeller & Jost, Pekin	17,165

PEORIA, ILL.—Bids are asked until June 15 for paving 38,240 sq. yds. with brick and 28,086 sq. yds. with asphalt, as stated in our advertising columns. Jacob Harman, Cy. Engr.

QUINCY, ILL.—The committee has recommended the paving of five streets, at an estimated cost of about $40,000.

URBANA, ILL.—Bids are asked until June 11 for grading and paving Main St. with brick. C. B. Holmes, Cy. Clk.—The committee estimates the cost of paving three streets at about $32,000.

WILMETTE, ILL.—About $27,000 will be expended for street improvements. Engrs., Alexander, Hill & Enricht, Chicago.

MILWAUKEE, WIS.—Bids are asked until June 14 for the purchase of $100,000 of 5% street improvement bonds. W. J. Fiebrantz, Cy. Comptroller.—The board of public works has recommended the paving of 13 streets with cedar blocks, granite or limestone.—The council has decided to pave a portion of Grand Ave. with asphalt.

RACINE, WIS.—The council has decided to pave South and North Main Sts. with cedar blocks.

WAUKESHA, WIS.—The question of paving the streets is reported as being agitated.

ARGENTINE, KAN.—The council is considering plans for paving six streets, for which $100,000 will be appropriated.

SEDALIA, MO.—The city is discussing the paving of the streets with macadam. Maj. Wm. Beck is interested.

ST. LOUIS, MO.—Bids are asked by the board of public improvements until June 22 for improving parts of 24 streets.

HOUSTON, TEX.—The council is discussing the paving of 11 streets.

TORONTO, ONT.—E. H. Keating, Cy. Engr., has recommended the paving of two streets with asphalt; estimated cost, $25,850.

ELECTRIC LIGHT AND POWER.

MERIDEN, CONN.—The citizens are reported to have voted to take immediate action to establish a municipal electric light plant.

KINGSTON, N. Y.—The council has been discussing plans for putting in an electric light plant.

NEWTON, N. J.—The contract for the erection of a building for an electric light plant has been awarded to Peter K. Van Scoten.

PINE GROVE, PA.—The Electric Light, Heat & Power Co. has been organized and will apply for a charter, according to reports.

WARREN, PA.—The plants of the Warren Gas Light Co. and Electric Light Co. were destroyed by fire May 27; loss, $6,000. The plants will be rebuilt at once.

HOPKINSVILLE, KY.—Bids aare asked until July 3 for 35 arc lights for street lighting. H. W. Tibbs, Cy. Clk.

PADUCAH, KY.—Bids are asked until June 25 for a franchise for an electric light plant. D. A. Yeiser, Mayor.

CARDINGTON, O.—It is reported that this place has voted to put in an electric light plant.

HAMILTON, O.—This city voted June 2 to issue $50,000 of additional electric light bonds.

NAPOLEON, O.—The council has passed an ordinance for the construction of an electric light plant. O. E. Reynolds, Cy. Clk.

ST. BERNARD, O.—Bids are asked until July 7 for the installation of an electric light plant, as stated in our advertising columns. Engr., Geo. Hornung, Cincinnati.

BAD AXE, MICH.—The citizens are discussing the question of an electric light plant.

KALAMAZOO, MICH.—Bids are asked for constructing a municipal electric light plant, according to reports.

DANVILLE, ILL.—It is reported that the Danville Gas, Electric Light & St. Ry. Co., will spend $10,000 for a 250-HP. engine and boilers.

DURAND, WIS.—F. J. Gobar writes us that no contracts for material or machinery have yet been awarded for the electric light plant, for which he has the franchise. It is proposed to do both arc and incandescent lighting, and the construction of the building is about completed.

CAPE GIRARDEAU, MO.—Isaac A. Smith, St. Louis, has been appointed consulting engineer of the electric light plant.

SPRINGFIELD, MO.—Bids have been received for an electric light plant. The committee is reported as in favor of a municipal plant; estimated cost about $68,000.

WAYNE, NEB.—It is reported that a franchise for an electric light plant will soon be granted.

BATESVILLE, ARK.—A company is to be organized to put in an electric light plant. J. S. Hanford is interested.

TORONTO, CAN.—E. H. Keating, Cy. Engr., has recommended the construction of a municipal plant. The estimated cost of a plant of 1,300 lights is $310,200.

NEW COMPANIES.—Inland Electric Co., Chicago, Ill.; $100,000; Carl Pehrson, G. E. Schumaker, Percy Taylor.—Union Electric Co., Cleveland, O.; $25,000; L. W. Bradley, J. E. Ensign, J. A. Osborne, J. B. Hicks.—Fort Wayne Electric Mfg. Co., Fort Wayne, Ind.; $10,000.—Suburban Electric Light & Power Co., Little Rock, Ark.; $50,000; Pres., G. B. Rose; Secy. and Treas., J. H. Healy.—Bimetallic Electric Transmission Co., Plainfield, N. J.; Willard M. Miner, Plainfield; W. H. Eckert and Wm. S. Eckert, New York, N. Y.—Independent Electric Co., Chicago, Ill.; increase of capital stock from $25,000 to $75,000.—Economic Electric Engine Co., Chicago, Ill.; $100,000; Chas. A. Jackson, Uriah Copp, Robert Doyle.—Sweet Electrical Mfg. Co., Grand Rapids, Mich.; $100,000.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

CHEMICAL ENGINE.—Wakonda, S. Dak.—A. V. Ferry, Town Clerk, wishes information regarding a chemical fire engine.

DREDGING AND FILLING.—Boston, Mass.—Bids are asked by the harbor commissioners until June 19 for filling about 120,000 cu. yds. and for dredging, as stated in our advertising columns.

SUBWAY.—Boston, Mass.—Bids are asked until June 9 for the construction of the Franklin St. subway. Wm. Jackson, Cy. Engr.

DISINFECTING PLANTS.—Fernandina, Fla.—Bids are asked until June 15 for the construction of a ballast crib and necessary buildings for a disinfecting station. Dr. J. L. Horsey, Asst. State Health Officer.

Brooklyn, N. Y.—Bids are asked until June 11 for the erection of a disinfecting plant at the Kingston Ave. hospital. Dr. L. Taylor Emery, Comr. of Health.

RAILWAY TRACK SCALE.—Cleveland, O.—Bids are asked until June 13 for furnishing a standard gage railway track scale of 60 tons capacity; platform 36 ft. long. J. H. Farley, Dir. Pub. Wks.

CANAL COMPANY.—Fremont, Neb.—The Fremont Canal & Water Power Co. has been incorporated by Wilson Reynolds, Robt. Bridge, L. P. Larson and others, to construct a canal for water power and irrigation purposes; capital stock, $1,500,000. It is proposed to generate electricity for manufacturing and other purposes.

BONDS.—Chicago, Ill.—Bids are asked until June 20 for the purchase of $1,786,000 of 20-year 4% gold bonds, including $785,000 sewerage bonds and $346,000 river improvement bonds. Wm. K. Ackerman, Cy. Comptroller.

GARBAGE REMOVAL AND PURCHASE.—Baltimore, Md.—Bids are asked by the street cleaning department until June 13 for the removal of garbage and purchase of street dirt and ashes for one or more years.

BARRACKS.—Fort Wayne, Mich.—Bids are asked until June 18 for constructing two double barracks. Capt. Geo. Ruhlen, Asst. Q. M., U. S. A.

COURT HOUSE.—Washington, D. C.—Bids are asked until June 27 for the superstructure of a U. S. court house and post office building at Mankato, Minn. Jeremiah O'Rourke, Superv. Arch.

ARMORY.—Cleveland, O.—YBids are asked by the county commissioners until June 26 for an armory for the 5th Regiment.

LIBRARY BUILDING.—East St. Louis, Ill.—Bids are asked until June 11 for the erection of a $40,000 library building. F. F. Parry, Secy.

SCHOOL BUILDING.—Richmond, Ind.—Bids are asked until June 9 for the erection of a $35,000 school building. Arch., W. S. Kaufman. Daniel Surface, Pres. Bd.

PLANS FOR A HOTEL.—Richmond, Ind.—Competitive plans are asked until June 9 for a $70,000 hotel. John M. Loutz, Secy., Commercial Club.

RIPRAP.—Memphis, Tenn.—Bids are asked for 45,000 cu. yds. of riprap rock to be delivered on barges or at Plum Point Reach, Ark. J. S. McTight & Co., 6 West Court St.

DREDGING.—New York, N. Y.—Bids are asked by the department of docks until June 21 for dredging 92,500 cu. yds. in the North River; also for 100,000 cu. yds. of mud dredging.

CITY HALL.—Lansing, Mich.—An election was held June 5 to vote on building a $75,000 city hall.

DITCH.—Washington, Ind.—Bids are asked until June 30 for constructing a drainage ditch. Edward C. Eaith, Drainage Comr.

DAM.—Helena, Mont.—The House has passed a bill authorizing the construction of a dam across the Missouri River near Stubb's Ferry. The work has been projected for several years and about $25,000 is said to have been already spent on the project. Wm. Muth is interested.

FIRE HOSE.—New York, N. Y.—Bids are asked by the fire commissioners until June 20 for fire hose, as follows: 2½-in., Eureka brand, 10,000 ft.; 2½-in., Maltese brand, 12,000 ft.; 3½-in., 1,000 ft.; 4-in., 700 ft.

ELEVATOR.—Washington, D. C.—Bids are asked until June 22 for an electric passenger elevator for the U. S. court house and post-office building, at Lincoln, Neb., as stated in our advertising columns. Jeremiah O'Rourke, Supervising Arch.

STONEWORK.—Newport, R. I.—Bids are asked until July 17 for stonework at Stonington breakwater, as stated in our advertising columns. Capt. W. H. Bixby, U. S. A.

METAL WORK.—New Orleans, La.—Bids are asked until July 3 for the metal work required for increasing the height of the tower at Key West, Fla. Maj. Jas. B. Quinn, U. S. A.

PARK IMPROVEMENTS.—Providence, R. I.—Bids are asked until June 9 for excavating 200,000 cu. yds. of mud from Cunliff's Pond, building 50,000 sq. yds. macadam road, etc., in Roger Williams Park. R. H. Deming, Chn. Comrs.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
June 8.	Sewers,	Troy, N. Y.	May 31
June 8.	Granite paving,	Troy, N. Y.	May 31
June 8.	Bridges,	Philadelphia, Pa.	June 7
June 8.	Sewers,	Philadelphia, Pa.	June 7
June 8.	Water-works system,	Danville, Ky.	May 24
	Advertised, Eng. News, May 3 to 24.		
June 9.	Water-w'ks and sewers,	Helena, Mont.	May 24
June 9.	Water-works bonds,	Pender, Neb.	May 24
June 9.	Sewers,	Sandusky, O.	May 31
June 9.	Sewers,	Altoona, Pa.	June 7
June 9.	Sewers,	Central Falls, R. I.	June 7
	Advertised, Eng. News, May 31.		
June 9.	Subway,	Boston, Mass.	June 7
June 9.	Road,	Rockport, Mass.	June 7
June 9.	Park improvements,	Providence, R. I.	June 7
June 9.	School building,	Richmond, Ind.	June 7
June 9.	Plans for hotel,	Richmond, Ind.	June 7
June 9.	Water bonds,	Pender, Neb.	June 7
June 11.	Ft. Harrison, U.S.A.,	Helena, Mont.	May 17
June 11.	Paving,	Gloversville, N. Y.	May 24
	Advertised, Eng. News, May 24 and 31.		
June 11.	Grading, Bond Hill,	O.	May 24
June 11.	Cobblestone paving,	Brooklyn, N. Y.	May 31
June 11.	Paving,	New York, N. Y.	May 31
June 11.	Macadamizing,	Montclair, N. J.	May 31
June 11.	Pipe, wells, etc.,	Fremont, Neb.	May 31
June 11.	Water supply (1 year),	Houston, Tex.	May 31
June 11.	Street lighting,	Houston, Tex.	May 31
June 11.	Sewer house con's,	Dayton, O.	June 7
June 11.	Dis'nfecting plant,	Brooklyn, N. Y.	June 7
June 11.	Library bldg.,	East St. Louis, Ill.	June 7
June 11.	Brick paving,	Urbana, Ill.	June 7
June 11.	Pmpg station, etc.,	Downer's Grove, Ill.	June 7
	Advertised Eng. News, May 31.		

June 11. Paving and grading, Newark, N. J.....June 7
June 11. Street improvements, Bond Hill, O.....June 7
June 12. Asphalt paving, Schenectady, N. Y....May 10
June 12. Street improvements, Cincinnati, O....May 24
June 12. Street improvem'ts (22), St. Louis, Mo. May 24
June 12. Water-works system, Brunswick, Mo..May 24
Advertised, Eng. News, May 24.
June 12. Electric light plant, Brunswick, Mo..May 24
Advertised, Eng. News, May 24.
June 12. Bridge, Gettysburg, Pa.....May 31
June 12. Grading, etc., Revere, Mass.....June 7
June 12. Brick paving, Waverly, N. Y.....June 7
June 12. Granite paving, Schenectady, N. Y.....June 7
June 13. Iron bridge spans, Hawkinsville, Ga..May 3
Advertised, Eng. News, May 3 to June 7.
June 13. Sewers, Cleveland, O.....May 24
June 13. Fireboat, Cleveland, O.....May 24
June 13. Sewers, Meadville, Pa.....June 7
June 13. Garbage removal, Baltimore, Md.....June 7
June 13. Ry. track scale, Cleveland, O.....June 7
June 13. Brick paving, Cincinnati, O.....June 7
June 13. Pipelaying (27 streets), Chicago, Ill....June 7
June 13. Sewers, Chicago, Ill.....June 7
June 13. Bridge, Fort Dodge, Ia.....June 7
June 14. Water-works system, Norfolk, Conn...May 17
Advertised, Eng. News, May 17 and 24.
June 14. Sewer plans, Sacramento, Cal.....May 24
June 14. Sewers, Cincinnati, O.....June 7
June 14. Street imp'v't bonds, Milwaukee, Wis..June 7
June 14. Railway (5.9 miles), Helena, Mont.....June 7
June 14. Water-works system, Penn Yan, N. Y..June 7
Advertised, Eng. News, May 17 and June 7.
June 15. Electric lt. plt., Hosp., Portland, Ore..May 31
Advertised, Eng. News, May 31, June 7.
June 15. Water-works, Gallipolis, O.....May 31
Advertised, Eng. News, May 31, June 7.
June 15. Pipe, Rochester, N. Y.....June 7
Advertised, Eng. News, June 7.
June 15. Paving, Louisville, Ky.....June 7
June 15. Cedar block paving, Freeport, Ill.....June 7
June 15. Disinfecting plant, Fernandina, Fla....June 7
June 15. Pipe, Sandusky, O.....June 7
Advertised, Eng. News, June 15.
June 15. Pipe sewer, Green Bay, Mich.....June 7
June 15. Pipe sewers, Freeport, Ill.....June 7
June 15. Paving, Peoria, Ill.....June 7
Advertised, Eng. News, June 7.
June 16. Water tank, Fort Monroe, Va.....May 24
June 16. Bonds, Faribault, Minn.....May 24
June 16. Dredging, Portland, Me.....May 31
Advertised, Eng. News, May 31 to June 14.
June 16. Highway, Mount Cory, O.....May 31
June 16. Macadamizing, Norwood, O.....May 31
June 16. Water bonds, Winnebago City, Minn..May 31
June 16. Water-works system, Pender, Neb.....June 7
June 16. Grading, Akron, O.....June 7
June 18. Highway, Little Rock, Ark.....May 14
June 18. Sewer house connections, Dayton, O..June 7
June 18. Sewer bonds, Bridgeport, O.....June 7
June 18. Brick paving, Montgomery, Ala.....June 7
June 18. Barracks, Fort Wayne, Mich.....June 7
June 18. Laying service pipes, Dayton, O.....June 7
June 18. Brick paving, Sandusky, O.....June 7
June 19. Alley improvem'ts (24), St. Louis, Mo..May 24
June 19. Dredging and filling, Boston, Mass....June 7
Advertised, Eng. News, May 31, June 7.
July 3. Pipe, Victoria, B. C.....May 24
July 3. Metal work at Key West, Fla.....June 7
Advertised, Eng. News, June 7 to 28.
July 3. Electric lighting, Hopkinsville, Ky....June 7
July 3. Sewer bonds, Hamilton, O.....June 7
July 7. Water-works, St. Bernard, O.....June 7
Advertised, Eng. News, June 7 to 21.
July 7. Electric light plant, St. Bernard, O....June 7
Advertised, Eng. News, June 7 to 21.
July 9. Bridge, Dallas, Tex.....June 7
July 10. Bridge, Cathlamet, Wash.....May 31
July 17. Stone work, Newport, R. I.....June 7
Advertised, Eng. News, June 7 to 28.
No date. W.-w. franchise, Ft. William, Ont....May 31
" " . Sewer plans, Dowagiac, Mich.....May 31
" " . Pipelaying (3 miles), Foxboro, Mass...June 7
" " . Water-works franchise, Edgerton, Wis. June 7
" " . Brick paving, Philipsburg, Pa.....June 7
" " . Riprap rock, Memphis, Tenn.....June 7

CONTRACT PRICES.

BRIDGE.—East Wheatland, Ill.—Bids were received May 16 for the masonry and superstructure of a 150-ft. span steel highway bridge, with a 16-ft. roadway. Engr., O. R. Rauchfuss, Joliet, Ill. The bidders for the masonry were all residents of Joliet, Ill., and the prices given per cubic yard include all excavation, cofferdams, etc. They were as follows:

Valentine Werner	$7.85	Riley & McCowan	$6.94
R. C. Morrison	8.35	Campbell & Dennis	8.70
C. J. Smith	7.10	A. Wenberg (award-	
Alexander & Robinson	6.95	ed contract)	6.00

The bids for the superstructure were as follows:

R. D. Wheaton, Chicago, Ill.	$3,230
Lane Bridge Co, Chicago, Ill.	3,220
St. Joseph Bridge Co., St. Joseph, Mo.	3,336
Lafayette Bridge Co., Lafayette, Ind.	3,300
Milwaukee Bridge Co., Milwaukee, Wis.	3,200
R. C. Morrison, Joliet, Ill (awarded contract)	3,125
Chicago Bridge & Iron Co., Chicago, Ill.	3,142
Youngstown Bridge Co., Youngstown, O.	3,150
King Bridge Co., Cleveland, O.	3,333
Massillon Bridge Co., Massillon, O.	3,275

WATER-WORKS.—Dolgeville, N. Y.—W. H. Bacon, Secy. Comrs., writes us that bids were received May 25 from 29 bidders for the proposed gravity system of water-works, recently advertised, the lowest prices for materials being as follows: 20 to 4-in. pipe, 1,295 tons, $22.40 per gross ton; special castings, 40,000 lbs., 2½ cts. per lb.; 20-in. valve, light pressure, $70 (one bid at $45); 12-in., $25; 12-in. valve, heavy pressure, $27.30; 10-in., 9, $20.38 each; 8-in., 8, $15; 6-in., 25, $9; 4-in., 24, $6; air valves, 3, $3; valve boxes and covers, 72, $2.50; double-nozzle fire hydrants, 58, $18.42 (one bid at $13); triple-nozzle, 2, $23 (one bid at $18). The lowest bid for trenching, pipelaying and backfilling was that of Smith Bros., at 29, 29, 24, 22, 18 and 16 cts. per lin. ft. for 20, 12, 10, 8, 6 and 4-in. pipe, respectively, $22 for a copper strainer and $10 for an iron strainer. The bids for the work complete were Smith Bros., at $52,124; Inman Bros. Construction Co., $55,689; Troy Public Works Co., $59,260; Geo. B. Grannis, $65,672. The bids for constructing the reservoir were as follows:

Bids Received for Constructing Reservoir, Dolgeville, N. Y.

Quantities.	Elevine & Devine Schenectady.	Geo. D. Granals, Syracuse.	Syracuse Const'n Co., Syracuse.	Hallinan Bros. & Fenton, Little Falls.	Smith Bros., Pelhamville.	L. J. Richardson and F. G. Ferris, Cortland.	Jos. Gallo and F. Cazzo, N. Y.	Inman Bros., New York.	Flood & Sherrill, Sandy Hill.	Troy Public Wks. Co., Troy.	Gaille & Gow, Dolgeville.	Thomas Kearney, Little Falls.
Clear'g and grub'g, 3½ acres	$75.00	$50.00	$50.00	$50.00	$75.00	$150.00	$25.00	$100.00	$25.00	$50.00	$75.00	$85.00
Excavation, 4,000 cu. yds...	.28	.30	.40	.28	.30	.44	.35	.28	.40	.30	.35	.50
Concrete, 600 cu. yds.....	4.75	5.25	5.00	5.50	4.00	6.60	4.50	4.75	5.25	5.50	5.45	5.90
Masonry, 240 " "	5.75	5.50	6.00	6.00	6.00	8.80	6.00	6.00	7.00	5.50	6.15	7.00
Coping and steps, 290 cu. ft.	1.10	1.50	1.50	.75	.80	2.20	1.25	.75	1.00	.50	.90	.90
Quarry waste fill'g, 35 cu. yds.	1.75	1.00	.50	1.00	1.00	1.65	.75	3.00	1.50	2.00	1.00	3.00
Soil dressing, 140 cu. yds...	1.25	.40	.33	.75	.30	.33	.40	.50	.60	.40	.25	.50
Gravel dressing, 70 cu. yds..	1.50	1.00	.60	.75	.30	.55	.40	1.00	.50	.50	.30	.50
Sodding, 500 sq. yds.....	.30	.30	.30	.10	.18	.33	.25	.25	.30	.30	.25	.50
Gate house, except masonry.	200.00	30.00	50.00	100.00	30.00	400.00	50.00	100.00	150.00	100.00	50.00	50.00
Wire fence, 182 rods.....	1.00	1.00	1.00	1.00	1.25	2.00	2.25	1.75	1.25	2.20	1.70	1.00

June 20. Railway excavation, Evansville, Ind...May 24
Advertised, Eng. News, May 24 to June 14.
June 20. Lining tunnel, Evansville, Ind.....May 24
Advertised, Eng. News, May 24 to June 14.
June 20. Reservoir, Lowville, N. Y.....May 24
June 20. Fire hose, New York, N. Y.....June 7
June 20. Bridge, Caldwell, Tex.....June 7
June 20. Sewer plans, Sacramento, Cal.....June 7
June 20. Bonds ($1,786,000), Chicago, Ill.....June 7
June 21. Dredging, New York, N. Y.....June 7
June 21 Brick paving, Ithaca, N. Y.....June 7
Advertised, Eng. News, June 7.
June 21. Paving, Williamsport, Pa.....June 7
Advertised, Eng. News, June 7 to 14.
June 22. Bridge abutments, Hamilton, O.....June 7
June 22. Elevator, pub. bldg., at Lincoln, Neb..June 7
Advertised, Eng. News, June 7 to 14.
June 22. Street imp'v'ts (24), St. Louis, Mo.....June 7
June 23. Sewers, Portsmouth, Va.....May 31
Advertised, Eng. News, May 31, June 7.
June 23. Sewers, Akron, O.....June 7
June 23. Water-works system, Fullerton, Neb....June 7
June 25. Water-works bonds, Cadiz, O.....May 31
June 25. Water-works system, Farmington, Ill..May 17
Advertised, Eng. News, May 17 to 31.
June 25. Electric franchise, Paducah, Ky.....June 7
June 25. Bonds, Madisonville, O.....June 7
June 25. Bridge bonds, Hastings, Minn.....June 7
June 26. Armory, Cleveland, O.....June 7
June 27. Courthouse at Mankato, Minn.....June 7
June 27. Brick paving, Oak Harbor, O.....June 7
June 28. Sewer, Cincinnati, O.....June 7
June 28. Lowering machinery, Huntington, Ind...June 7
June 29. Street improvement bonds, Norwood, O..June 7
June 30. Bridge, Marion, Ind.....June 7
June 30. Ditch, Washington, Ind.....June 7
July 1. Sewer bonds, Wallace, Idaho.....May 31
July 1. Water-works, Lancaster, N. Y.....June 7
Advertised, Eng. News, June 7 and 14.
July 2. Water-works system, Centreville, S. Dak. May 31
July 2. Paving, Dayton, O.....June 7
July 2. Bridge, Hastings, Minn.....June 7
Advertised, Eng. News, June 7.

BOILERS.—Dayton, O.—The following bids were received May 29 for four 150-HP. water-tube boilers and two steam receivers:

Babcock & Wilcox Co., Chicago, Ill.	$12,403 and $10,366
Enterprise B'l'r Wks. Youngst'n, O., Adams b'l'r	7,500
Campbell & Zell Co., Baltimore, Md.	13,269
Stirling Co., Cincinnati	8,400
Nat'l Water-Tube Boiler Co., New Brunsw'k, N. J	9,210
Wickes Bros., East Saginaw, Mich.	8,954
Heine Safety Boiler Co., St. Louis, Mo.	11,397
Brownell & Co., Dayton, O., horiz. tub.	3,950
Abendroth & Root Mfg. Co., New York	9,900

PIPE.—Youngstown, O.—W. S. Hamilton, W. W. Supt., writes us that the lowest bid for 1,000 tons of 24 to 16-in. cast iron pipe was that of the Addyston Pipe & Steel Co., at $16.34 per ton. The city paid $21.75 per ton for similar pipe last year.

Bradford, Pa.—E. N. Hallock, Secy. Comrs., writes us that a contract for 11,180 ft. of 6 and 4-in. pipe has been awarded to the Addyston Pipe & Steel Co., Addyston, O., at $17.75 per ton of 2,000 lbs.; special castings, 2¼ cts. per lb. The contract for hydrants, gate valves and boxes was awarded to R. D. Wood & Co., Philadelphia.

Springfield, O.—E. C. Gwyn, Pres. Bd., writes us that the contract for 24-in. pipe, recently advertised, has been awarded to Dennis Long & Co., Louisville, Ky., at $16.24 per ton of 2,000 lbs., f. o. b. cars in Springfield.

Brockville, Ont.—B. J. Saunders, Engr., writes us that a contract for about 6,000 ft. of 10-in. pipe has been awarded to the Drummond McCall Pipe Foundry Co., Montreal, at $29 per ton; special castings, 2 cts. per lb. The Canada Pipe Foundry Co., Montreal, bid $30 and 2½ cts.

PIPE, PIPELAYING, ETC.—Springfield, O.—D. F. Snyder, Asst. Cy. Engr., writes us that there were about 100 bidders for the work recently advertised and that contracts have been awarded as follows: Dennis Long & Co., Louisville, Ky., 1,708 tons of 24-in. pipe, $16.24 per ton; flange specials, $47; special castings, $39; Toledo Construction Co., Toledo, O., laying pipe, 44 cts. per lin. ft.; brickwork and valve vaults, $15 per M. brick; Rensselaer Mfg. Co., Troy, N. Y., 24-in. valves, bevel gear, $146.

SEWERS.—Concord, N. H.—W. B. Howe, Cy. Engr., writes us that the contract for building the Allison St. sewer has been awarded to Wm. S. Marsh, Lawrence, Mass., at $8.57 per lin. ft. for 700 ft. of 30-in. pipe sewer, and $39 each for 3 manholes.

Brooklyn, N. Y.—The following bids were received May 25 for constructing a cement pipe sewer:

	J. J. Van Ostrand.	E. J. Clark.	Jas. Jennings.	F. A. Gillen.
12-in. pipe, at.....	$1.35	$0.86	$0.87	$0.85
15-in. " "	1.65	1.16	1.15	1.00
18-in. " "	1.80	1.44	1.39	1.30
24-in. " "	1.95	2.08	1.89	1.83
Manholes, "	28.00	32.00	31.00	31.00
Street basins, at...	100.00	96.00	99.00	95.00

Rochester, N. Y.—The contract for the Thomas St. outlet sewer has been awarded to (1) H. N. Cowles, at $21,420, the other bidders being (2) Bruff, Horn & Co., $23,180, and (3) Brayer & Albaugh, $33,806; engineer's estimate, $25,100. The prices were as follows:

		1.	2.	3.
24-in. pipe, 340 ft.		$2.50	$2.48	$2.47
22 × 33-in. brick,	480 ft.	3.00	3.45	4.92
26 × 39-in. "	265 ft.	3.50	3.71	5.44
36 × 54-in. "	1,024 ft.	4.00	4.85	6.28
40 × 60-in. "	637 ft.	4.50	5.13	7.98
30 × 45-in. "	258 ft.	3.00	4.45	6.55
36 × 54-in. "	272 ft.	4.00	4.85	7.73
60-in. "	789 ft.	6.50	5.86	9.70
62-in. "	360 ft.	6.50	6.52	10.74
Surface sewers, new, 33.		20.00	21.00	30.00
6-in. slants, in br'k sewers,	158	1.00	0.75	1.00
18-in. " " " "	2	1.50	3.00	3.00
24-in. Y-branches,	14	2.00	2.00	5.00
Manholes, new, 16.		35.00	30.00	35.00
Con. with trunk sewer, incl. shaft tunnel and m'hole complete...		500.00	700.00	585.00

ASPHALT PAVING.—Milwaukee, Wis.—Contracts for paving with asphalt on a five-year guarantee, have been awarded as follows: Western Paving & Supply Co., Milwaukee, 18,562 sq. yds. at $2.42, stone curb at 60 cts. and resetting curb at 15 cts. per lin. ft., and 9,000 sq. yds. at $2.46; Warren-Scharf Asphalt Paving Co., New York, 9,852 sq. yds. at $2.55, stone curb at 62½ cts. and resetting curb at 12 cts. per lin. ft., and 3,425 sq. yds. at $2.44. The bidders for the work in Wisconsin St., 18,562 sq. yds., were as follows: Western Paving & Supply Co., $2.42; Barber Asphalt Paving Co., $2.81; Warren-Scharf Asphalt Paving Co., $2.48; United States Asphalt Co. (California asphalt), $2.57; J. J. Crilley, Milwaukee, $2.89; N. F. Reichert, Racine, $2.79.

Philadelphia, Pa.—Bids were opened May 29 for about $1,500,000 worth of street work, including a large amount of paving with asphalt. The asphalt paving contracts were awarded as follows: Vulcanite Paving Co., 39 contracts for paving with Trinidad Lake asphalt upon concrete, at $2.50 per sq. yd., and 19 contracts for sheet asphalt upon bituminous base, at $2.40 to $2.45; Pennsylvania Asphalt Paving Co., 18 contracts for Bermudez asphalt upon concrete, at $2.45 to $2.46; Philadelphia Paving & Construction Co., 12 contracts for repaving with rock asphalt upon concrete, at $2.05 to $2.49; California Petroleum & Asphalt Co., 4 contracts for Alcatraz asphalt, at $2.40.

STONE PAVING.—Troy, N. Y.—The contract for paving Front St., between Division and Adams Sts., with granite blocks, has been awarded to (4) Casey & Cavanaugh, at $11,785; the other bidders being (1) Besch & Farrell, (2) Martin Muray, (3) J. H. Cavanaugh. The bids were as follows:

	1.	2.	3.	4.
Paving, per sq. yd.	$2.69	$2.93	$2.84	$2.73
Curbing, per lin ft.	.72	.57	.55	.68
Granite bridging, per sq. ft..	.60	.25	.75	.60
Redressing old curb, per lin. ft.	.20	.15	.25	.07
" " brid'g, " " "	.20	.55	.20	.07

Rochester, N. Y.—The following bids have been received for paving State St., 10,700 sq. yds., with Medina blocks, with concrete foundation and pitch joints, the engineer's estimate being $57,000:

	Paving.	Flag walks, lin. ft. Side walks, 9½ ft.	Cr'swalks, 5½ ft.	Curb, 6-in.	Total.
Bruff, Horn & Co.	$3.00	$.50	$5.71	$3.24	$1.00	$42,139
Whitmore, Rauber & Vicinus*	3.24	.28	4.30	2.50	.95	41,758
Chambers & Casey.	3.20	.40	5.00	3.00	1.00	42,650
Gilbert, Brady & Co.	3.32	.05	4.55	2.65	1.07	42,387
Rock Asphalt P. Co.	3.30	.50	4.50	3.00	.90	44,093
Brayer & Albaugh.	3.30	.60	5.12	3.30	1.00	43,985
H. N. Cowles.	3.40	.75	6.00	3.50	1.25	47,150
Lauer & Hagaman.	3.50	.40	5.50	3.25	.95	46,290
W. H. Jones & Sons.	3.60	.60	7.00	5.00	1.00	50,577

* Awarded contract.

BRICK PAVING.—Parkersburg, W. Va.—W. H. Ogdin, Cy. Clk., informs us that the bids per square yard for 12 contracts for paving with brick with sand filling ranged as follows:

Martin Hare, Parkersburg, W. Va.	$ .97
Con. Kennedy, " " "	$ .95 to 1.07
Otto Lehman, " " "	.88 " 1.03
Day's & Archer, Bellaire, O.	.92 " 1.05
E. A. Freshwater, Penrith, W. Va.	.80 " .80
E. M. Ayers, Zanesville, O.	.97 " 1.06
Thos. J. Steers, Parkersburg, W. Va.	.96 " 1.10
Erberk Bros., Homestead, Pa.	.91 " 1.04
Rosser & McCrady, Bellaire, O.	.82 " .95
Carney & Mahoney, Parkersburg, W. Va.	.845 " .965
W. J. Berry, Dife's Bottom, O.	.83 " .89
John Guest, Parkersburg, W. Va.	1.04 " 1.15
L. Cramer & Son, " " "	1.05 " 1.08

The bids for tar filling, ranged from 7 to 15 cts. per sq. yd. extra. The following additional bids per lineal foot were also received for sandstone curbing:

L. A. Mullen, Buchannon, W. Va.	$0.48
Joseph Cavanaugh, Parkersburg, W. Va.	.49
Samuel Keenan, Parkersburg, W. Va.	.42 to .57
P. V. Doyle, Parkersburg, W. Va.	.47
Martin McNerney, Parkersburg, W. Va.	.38

Marshalltown, Ia.—Wm. Bremner, Cy. Engr., writes us that the contract for paving with brick, recently advertised, has been awarded to R. J. Donelly & Co.,

Davenport, Ia., at $1.40 per sq. yd., for two courses of brick upon present macadam, also at same price upon sand.

PAVING BRICK.—Wilmington, Del.—Contracts for fire brick for paving have been awarded as follows: Geo. H. McCall Co., Agent, 9,014 sq. yds. Barrington brick, at 99 cts. per sq. yd.; Canton Shale Exchange, Canton, O., 4,924 sq. yds. Metropolitan blocks, at $1.13; C. Warner Co., Agent, 1,310 sq. yds. Toronto, O., repressed fire clay brick, at $1.07; J. C. Bolen, Agent, 1,433 sq. yds. Hallwood blocks, Zanesville, O., at $1.05; Interstate Vitrified Brick Co., Philadelphia, 5,316 sq. yds. Keystone shale brick, at 90 cts.

PUMPING ENGINE.—Springfield, O.—J. D. Cook, Engr., Toledo, informs us that the following bids were received May 24 for a 10,000,000-gallon pumping engine, the table showing in comparison the dimensions, current economy in service and estimated commercial value when operated at contract speed, interest computed at 5% and coal estimated at $2 per ton of 2,000 lbs.:

STAND-PIPES AND FOUNDATIONS.—Youngstown, O.—Bids were received May 29 for two 30 × 100-ft. steel stand-pipes and foundations. The prices for the foundations ranged as follows: Earth excavation, 25 to 40 cts. per cu. yd.; broken stone, $1.50; concrete, $3.90 to $6.45; masonry, $7.90 to $11.85. The bids for the stand-pipes were as follows:

Builder.	All lap joints.	Lap & butt joints.	All butt joints.
Stacy Mfg. Co. Cincinnati.	$22,668	$24,526	$27,352
Cunningham Iron Wks., South Boston, Mass.	.....	18,500	.....
W. B. Pollock & Co., Youngstown	24,227	26,558	29,626
Reeves Bros., Alliance	21,857	22,537	24,080
*Enterprise Boiler Wks., Youngstown	17,495	19,507 19,081	23,494
Riter & Conly, P'tsb'g, Pa	21,800	24,800	27,500
Brownell & Co., Dayt'n, O.	16,682	17,382	19,148

* Awarded contract at $17,495.

INDUSTRIAL NOTES.

THE BERMUDEZ ASPHALT CO., of Indianapolis, Ind., has awarded a contract to Hetherington & Brewer for constructing a plant to cost about $20,000.

THE CANADIAN LOCOMOTIVE & ENGINE WORKS, of Kingston, Ont., have the contract for the machinery for operating the gates of the Sault Ste. Marie canal. The cost will be about $40,000.

THE BROOKS LOCOMOTIVE WORKS, of Dunkirk, N. Y., have received from Flint & Co., of New York, an order for 30 passenger locomotives and 30 freight locomotives for the Central Railway of Brazil. This order will amount to nearly $750,000.

THE BROWN & SHARPE MFG. CO., Providence, R. I., is constructing an extension to its main building by which 50,000 sq. ft. will be added to its floor area. With the addition the total floor space of the company's works will be 272,000 sq. ft., or about 6¼ acres. The extension will be completed July 1.

BIDS RECEIVED AT SPRINGFIELD, O., FOR 10,000,000-GALLON PUMPING MACHINERY.

Bidder.	Cylinders. HP.	Int.	LP.	No. cylinders.	Water cylinder, inches.	Stroke, inches.	Piston speed, ft. per min.	Duty million gals. ft.-lbs. per 100 lbs. of coal. Evap'n, 10 lbs.	Evap'n, 8 lbs.	St'm pressure, lbs.	Price.	Foundation.	Total cost, less old engine.	Annual tons of coal. Evap'n, 10 lbs.	Evap'n, 8 lbs.	Annual cost of coal. Evap'n, 10 lbs.	Evap'n, 8 lbs.	Five per cent. int. on plant	Total annual cost interest and coal. Evap'n 10 lbs.	Evap'n 8 lbs.	Value of old engine.
E. P. Allis & Co., vert. trip	30	54	10	6	24	60	200	140	112	125	$78,000	.....	$74,900	3,261.41	4,076.76	$6,522.82	$8 153.52	$3,745.00	$10,267.82	$11,898.52	$3,100
" " " " comp	40	....	80	4	24 / 31½	60	175	110	88	120	59,000	.....	55,900	4,150.96	5,188.70	8,301.92	10,377.40	2,795.00	11,096.92	13,172.40	3,100
" " " hor. "	30	....	60	4	17	60	300	110	88	120	43,000	.....	39,900	4,150.96	5,188.70	8,301.92	10,377.40	1,995.00	10,291.92	12,372.40	3,100
" " " "	24	....	48	4	19	48	240	110	88	120	48,000	.....	44,900	4,150.96	5,188.70	8,301.92	10,377.40	2,245.00	10,546.92	12,622.40	3,100
Holly Mfg. Co., " Gaskell	27	....	50	4	23¾	38	166	110	88	100	43,650	$766.00	41,416	4,150.96	5,188.70	8,301.92	10,377.40	2,070.80	10,372.72	12,448.20	3,000
" " " vert. comp	35	....	64	4	24½ / 29¼	56	205	110	88	115	53,000	1,150.16	51,150	4,150.96	5,188.70	8,301.92	10,377.40	2,575.00	10,876.92	12,952.40	3,000
" " " " trip. exp	27	46¾	69	6	24½	56	240	125	100	125	62,500	1,517.24	61,017	3,652.92	4,566.15	7,305.84	9,132.30	3,050.85	10,356.69	12,183.15	3,000
Gro-hon H.D.Pump.Eng. Co. hor. trip. exp	38	51	51	6	15½	48	250	110	88	100	32,000	.....	30,000	4,150.96	5,188.70	8,301.92	10,377.40	1,500.00	9,801.92	11,877.40	2,000
H. R. Worthington,* hor. comp	30	....	60	4	26	48	130	105	84	125	34,200	.....	33,800	4,348.61	5,435.76	8,697.22	10,871.52	1,690.00	10,387.22	12,561.52	400
" " " "	27	....	54	4	26	36	130	105	84	125	29,000	.....	29,100	4,348.61	5,435.76	8,697.22	10,871.52	1,455.00	10,152.22	12,326.52	400
" " " trip. exp	22	34	60	6	26	36	130	125	100	150	38,100	.....	34,700	3,652.92	4,566.15	7,305.84	9,132.30	1,735.00	9,040.84	10,867.30	400
F. R. Dravoe & Co. " comp	36	....	66	4	17¼	48	300	110	88	100	35,500	.....	33,500	4,150.96	5,188.70	8,301.92	10,377.40	1,675.00	9,976.92	12,052.40	2,000
" " " "	37	....	61	4	17¼	48	300	115	92	136	35,000	.....	33,000	3,971.20	4,964.00	7,942.40	9,928.00	1,650.00	9,592.40	11,578.01	2,000
" " " " trip. exp	24	44	60	6	14	48	300	130	104	150	41,000	.....	39,000	3,512.39	4,390.48	7,042.78	8,780.96	1,950.00	8,992.78	10,730.96	2,000

Direct acting, all others rotative.

PUMPING ENGINES.—Youngstown, O.—J. D. Cook, Consult. Engr., Toledo, has sent us the following statement of the bids received May 29 for pumping machinery, showing in comparison the dimensions, current economy in service and estimated commercial value when operated at contract speed, or 10,000,000 gallons per 24 hours, interest being computed at 5% and coal estimated at $1.10 per ton of 2,000 lbs.; two pumping engines; head, 220 ft.:

METAL MARKET PRICES.

LEAD.—New York: 3.25 to 3.35 cts. Chicago: 3.2 cts. St. Louis: 3.05 to 3.15 cts.

NAILS.—Pittsburg: $1.10 for wire, and 95 cts. to $1 for cut at mill.

FOUNDRY AND PIG IRON.—New York: $10 to $13. Pittsburg: $9.75 to $11.25. Chicago: $10 to $11.50.

THE GEO. F. BLAKE MFG. CO., of New York, has fitted the U. S. Cruiser "Minneapolis" (which will soon be given a trial trip), as well as the sister ship "Columbia," with a complete outfit of Blake pumps, including special independent air-pumps for the main condensers, feed pumps, fire pumps, bilge pumps, etc.

THE WILSON & BAILLIE MFG. CO., of Brooklyn, N. Y., manufacturing Kosmocrete artificial stone sidewalks, floors, etc., has finished 15,000 sq. ft. of stable

BIDS RECEIVED AT YOUNGSTOWN, O., FOR 10,000,000-GALLON PUMPING MACHINERY.

Bidder.	Cylinders, ins.— H.P.	Int.	L.P.	Water cylinder, inches.	Stroke, inches.	Piston speed, ft. per min.	Duty million gals ft.-lbs. per 100 lbs. of coal. Evap'n, 10 lbs.	Evap'n, 7½ lbs.	St'm pressure, lbs.	Price.	Annual tons of coal. Evap'n, 10 lbs.	Evap'n, 7½ lbs.	Annual cost of coal. Evap'n, 10 lbs.	Evap'n, 7½ lbs.	Five per cent. int. on plant.	Total an'l cost, int. and coal. Evap'n, 10 lbs.	Evap'n, 7½ lbs.
Holly Mfg. Co., horizontal rotative, double acting	21	....	42	20	36	115	105	78¾	80	$50,900	3,183	4,241	$3,501	$4,665	$2 545	$6,046	$7,210
" " " " " " " "	18	....	36	18	32	140	100	75	80	41,300	3,343	4,453	3,678	4,898	2,065	5,748	6,963
Wilson-Snyder Mfg. Co., rotative cross comp., double acting	32	....	64	18	36	135	...	..	80	48,500	.....	.....	.....	.....	2,425	.....	.....
" " " " " " " "	26	....	52	18	36	135	110	82½	120	44,950	3,044	4,052	3,349	4,457	2,448	5,796 5,184	6,904 6,292
Geo. F. Blake Mfg. Co., horizontal cross comp., double acting	27	....	54	18½	42	140	110	82½	120	36,709	3,044	4,052	3,348	4,457	1,835	5,184	6,292
" " " " " " " "	21	....	42	14½	40	222	115	86¼	120	34,816	2,913	3,876	3,204	4,264	1,741	4,945	6,005
" " " " direct horizont'l duplex, rotative acting	22	....	41	2 22½	48	90	60	45	80	21,167	5,577	7,431	6,135	8,165	1,058	7,193	9,233
Dean Steam Pump Co., triple exp. direct acting, double acting	15	22½	37	2 22½	36	90	80	60	120	28,975	4,183	5,562	4,601	6,119	1,449	6,050	7,568
" " " " direct hor. comp., double acting	20	....	37½	2 22½	36	90	70	52½	120	26,950	4,782	6,358	5,260	6,994	1,348	6,607	8,342
H. R. Worthington, direct cross comp., double acting	18	....	36	2 19	36	...	105	78¾	120	41,500	3,183	4,241	3,501	4,665	2,075	5,576	6,740
" " " " " " " "	21	....	42	2 19	36	...	105	78¾	80	44,750	3,183	4 241	3.501	4.665	2,238	5,739	6,903
" " " " " " " "	25	....	43 3/10	2 22	36	...	65	48¾	...	33,500	5,147	6,847	5,661	7,532	1,675	7,336	9,208
Groshon High Duty Pumping Engine Co.	..	....	..	..	..	110	110	82½	120	37,750	3,044	4,052	3,349	4,457	1,888	5,236	6,344
" " " " " " hor. trip. exp., single acting	25	38	56	3 17½	48	...	125	93¾	...	52,000	2,679	3,562	2.947	3,919	2,600	5,547	6,519
" " " " " " cross comp., double acting	22½	....	49½	13½	42	...	110	82½	120	29 000	3,044	4,052	3,349	4,456	1,450	4,799	5,907
Frazer & Chalmers, double acting	20	....	34	2 17½	36	140	110	82½	...	48,600	3,044	4 052	3.349	4.457	2,430	5,779	6,887
" " rotative cross compound	..	....	..	..	..	280	115	86¼	...	32,000	2,913	3,876	3,204	4,264	1,600	4,804	5,864
Barr Pumping Eng. Co.† rotative cross comp., double acting	18	....	36	18	36	140	115	86¼	120	40,800	2,913	3,876	3,204	4,264	2,040	5,244	6,304
" " " " direct acting, double acting	20	....	40	22	36	90	80	60	120	27,400	4,183	5,563	4,601	6,119	1,370	5,971	7,489
Wm. Tod & Co.‡ rotative cross compound, double acting	24	....	48	18	36	140	110	82½	120	41,500	3,044	4,052	3,349	4,457	2,075	5,424	6,532
E. P. Allis Co., vertical triple, single acting	22	38	56	3 20¼	36	140	130	97½	120	58,000	2,577	3.424	2,835	3,766	2,900	5,735	6,666
" " " compound, differential	26	....	50	8	36	140	115	86¼	120	39,000	2,913	3,876	3,204	4,264	1,950	5,154	6,214
" " " " "	32	....	58	8	36	140	105	78¾	80	40,500	3,183	4.241	3,501	4,665	2,025	5,526	6,690
" " cross " double acting	24	....	44	2 19§	42	140	110	82½	120	34,000	3,044	4,052	3,340	4,457	1,700	5,049	6,157
" " " " " "	26	....	50	2 19§	42	140	100	75	80	35,000	3,343	4,453	3,677	4,898	1,750	5,428	6,648

* 30-in. stroke.
† If surface instead of jet condenser is wanted, add $2,000 to the price of each engine.
‡ At piston speed of 240 ft. per min., guaranteed duty of 120 millions and deliver 8,500,000 gallons of water each
§ 25 and 17¾.

MANHOLE CASTINGS.—Brunswick, Me.—It is stated that a contract for 120 manhole castings, each to weigh 500 lbs., has been awarded to the Le Baron Foundry Co., at $5.50 each. Local companies bid $8 and the Bath Iron Wks., $9.

ELECTRIC LIGHTING.—Omaha, Neb.—New bids were opened last week for 200 arc lights for three years for street lighting. Wm. Baker, Chicago, bid $95 per light and Mr. Wiley, $106. The Citizens' Electric Co. bid $87.50, the lights to be of 45 volts and 9½ amperes; also would furnish commercial lights at $16 per month for all-night service, $12 for each light to burn until midnight, or $10 until 10 o'clock, and 15 cts. per 1,000 watt-hours for incandescent lights.

ELECTRIC LIGHT PLANT.—Hawarden, Ia.—About 40 bids were received for constructing the proposed municipal incandescent electric light plant, recently noted, and the contract was awarded to J. H. Winchel, Le Mars, Ia., at $9,324. The plans and specifications were prepared by Wm. H. Bryan, Consult. Engr., St. Louis, and include a 36-K-W. Thomson-Houston alternator; a 12 × 30 Corliss engine; two 80-HP. steel boilers, with pole line; exterior and interior construction for 1,000 lamps of 16 c. p. and 50 of 32 c. p. for street lighting; converters, meters, etc. The plant will be completed within 90 days.

TRACK MATERIAL.—New York: angle bars, 1.2 to 1.4 cts.; spikes, 1.5 to 1.7 cts.; track bolts, 2 to 2.1 cts. with square and 2.1 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.35 to 1.4 cts.; spikes 1.6 to 1.7 cts.; track bolts, 2.15 to 2.25 cts., with hexagon nuts.

RAILS.—New York: $24 to $25 at eastern mills and at tidewater; old rails, $10 to $11 for iron, and $8.50 to $9 for steel; light rails, $22 to $24; girder rails, $21 to $24. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old, rails, $10 for iron and $9.50 to $10 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.35 to 1.5 cts.; channels, 1.35 to 1.5 cts.; angles, 1.25 to 1.35 cts.; tees, 1.5 to 1.6 cts; universal mill plates, 1.15 to 1.35 cts.; steel plates, 1.3 to 1.35 cts. for tank, 1.4 to 1.45 cts. for shell, 1.6 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.25 to 1.35 cts.; channels, 1.25 to 1.35 cts.; angles, 1.25 to 1.35 cts.; tees, 1.35 to 1.4 cts.; universal mill plates, 1.25 to 1.35 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.4 cts. for shell, 1.4 to 1.5 cts. for flange, 1.75 to 4 cts. for firebox. Chicago: beams, 1.45 cts.; channels, 1.45 cts.; angles, 1.4 cts.; tees, 1.6 cts.; universal plates, 1.45 cts.; steel plates, 1.45 to 1.5 cts. for tank, 1.5 to 1.6 cts. for shell, 1.65 to 2.1 cts. for flange, 2.5 to 5 cts. for firebox.

floors and 3,000 ft. of sidewalk at E. E. Wheeler's new stable at Berry and South Eighth Sts., Brooklyn, and also 3,500 ft. of platforms and landings at the water tower on Prospect Hill. It is now at work on 85,000 ft. of floor of drill room and basement and 30,000 ft. of sidewalk at the 14th Regiment armory, and has the contract for 25,000 ft. of sidewalk around the 23d Regiment armory at Bedford and Atlantic Aves., Brooklyn.

NEW COMPANIES.—La Fortune Trinidad Asphalt Co., Chicago, Ill.; $100,000; C. E. Easton, Charles P. Platt and E. T. Martin.——Engineers' Directory Co., Chicago, Ill.; $10,000; W. P. Lundy, W. R. Howard and A. F. Lenhart.——Otsolic Construction Co., Brooklyn, N. Y.; $6,000; bridges, wharves, railways, etc.; Walter M. Mesecrole.——Tappin Steam Pump Co., Chicago, Ill.; $40,000; Robert Weir, Robert Craig, F. P. Simons.——United States Engineer Supply Co., Chicago, Ill.; $200,000; John T. Judd, A. Cattell and James Mullen.——Artificial Stone Co., Fairmount, W. Va.; $100,000; C. E. Manly, W. T. Ravenscroft and N. A. Clayton.——Rotary Engine & Machinery Co., Chicago, Ill.; $100,000; Wm. Smith, W. A. Bennett and A. D. Smith.——Crystal Mountain Mining & Drainage Co., Denver, Colo.; $2,000,000; George W. Melton and James Usher.——Robinson Phosphate Co., Kansas City, Mo.; $6,000; W. D. Clark, W. John Robinson.